



**TALWANDI SABO POWER LIMITED**

**Tender Specification No: TN/CM/TSPL/2018-19**

**BIDDING DOCUMENT AND TECHNICAL SPECIFICATIONS**

For

**CONSTRUCTION OF OFFICE SERVICE BUILDINGS**

For

**TALWANDI SABO POWER LIMITED (OWNER)**

**1980 MW SUPERCRITICAL THERMAL POWER PLANT**

**(3 X 660 MW)**

**AT VILLAGE BANWALA, DISTT. MANSA,**

**PUNJAB, INDIA**

**09<sup>th</sup> MAY 2018**

## 1. INSTRUCTIONS TO BIDDERS

Bidder shall submit a signed declaration along with the offer as a token of acceptance of TSPL's terms and conditions. If any Bidder is unable to accept any particular term(s) of the Bid; or propose any deviation there from, except for vital terms mentioned in this Bid document; then the bidder shall enclose a statement of deviations along with their offer clearly spelling out the deletions and deviations proposed. Which may, however have an impact on the evaluation of his offer by TSPL, in case such deviation(s) is acceptable to TSPL. Absence of details of deviations to Bid terms shall be considered as deemed acceptance by the Bidder of all terms and conditions contained herein.

- 1.1. PRICE: Bidder shall quote charges as per BOQ given in this document. If there is any discrepancy between the figures and written words, the owner shall consider lower of the two as the quoted price.
- 1.2. TSPL reserves the right to reject/accept any bid(s) received either for the total scope of work or part thereof, or to divide the scope of work on more than one Bidder, or negotiate with any Bidder for order without assigning any reason thereof, and no bidder shall be entertained for claim in this respect. In case of non- acceptance of bid by TSPL for any reason whatsoever, the Bidder shall have no claim for the expenses incurred by him in submitting his Bid or on any other account. It shall not be obligatory for TSPL to accept the lowest or any Bid; and no Bidder shall be entitled to demand any explanation for the cause of rejection of his Bid. Such decisions by TSPL shall bear no liability whatsoever consequent upon such decisions and TSPL reserves its exclusive right to ignore all such demands.
- 1.3. The Bid shall be signed by anyone, legally authorized to enter into commitments on behalf of the Bidder. Bidder shall submit Power of Attorney in favour of the person who is authorized to enter into commitments on behalf of Bidder.
- 1.4. TSPL will not be bound by any Power of Attorney granted by the Bidder or changes in the composition of the firm made subsequent to submission of the offer or award of the contract. TSPL may however, recognize such power of attorney and changes after obtaining proper legal advice, the cost of which will be chargeable to the Bidder.
- 1.5. The Bidder should communicate the cancellation of any documents such as Power of Attorney, Partnership Deed etc. in writing well in time, failing which it shall have no responsibility or liability for any action taken by it or the strength of the said documents.
- 1.6. All direct and indirect costs for preparation of the offer (including clarification meetings), shall be to Bidder's account and TSPL shall bear no liability whatsoever on such costs and expenses.
- 1.7. You shall make your own interpretation of any and all information provided in the Bid documents. TSPL shall not be responsible for the accuracy or completeness of such information and/ or interpretation. You shall be responsible for obtaining and verifying all necessary data and information.
- 1.8. 1.1.8 You shall make your own interpretation of any and all information provided in the Bid documents. TSPL shall not be responsible for the accuracy or completeness of such information and/ or interpretation. You shall be responsible for obtaining and verifying all necessary data and information.

1.9. BIDDER'S PERFORMANCE: In addition to other requirements specified elsewhere in this Bid document, the Bidder should necessarily furnish the following to evaluate their performance for participating in this Bid. Full details supported with documentary evidence; wherever required, should be furnished.

A. Name & Addresses:

- i. The address in full (including Registered Office, and all branches wherever located, giving telephone, telex and fax numbers; names of the Senior Executives of the respective offices should also be given).
- ii. Name and addresses of all the Associate/Sister/ Affiliate/Agent Companies wherever located.

B. Past & Current Orders: Details of work similar to that mentioned in this bid document during past 3 years and orders currently under execution

- i. Name & address along with Telephone/Fax numbers and name of contact person.
- ii. Copy of Orders (un-priced)
- iii. Completion period (Schedule v/s Actual).
- iv. Performance reports mentioning specific achievements

C. Bidder shall furnish the details of personnel associated with it along with qualification and experience. Bidder shall attach plan as to how it will carry out the work envisaged in this bid document.

D. If required, TSPL team may inspect works where Bidder has rendered or has been rendering similar services for verification/assessment

E. **Annual Reports:** Published Annual Reports of the Bidder for the last three years.

F. **Creditworthiness:** Name and address of the Bidder's bankers and solvency certificate from First Class Bank of the country.

1.10. Eligibility Criteria:-

- i. Party should have executed at least two similar jobs for minimum executed order value of 5 Crore INR in last 3 years.
- ii. Turnover more than 10 Crores INR per annum for last 3 years

1.11. The Bidder shall keep the offer open for acceptance by TSPL for a minimum period of 90 days within which period the Bidder shall have no right to withdraw, revoke or cancel his offer or vary the offer given or any term thereof.

1.12. The Bidder shall submit the proposal in three (3) sets - (One original with two copies), with one soft copy on a compact disc (CD) along with the originally signed copy of the Declaration Notice.

a. The bid shall be addressed to:-

**Head Commercial**  
**Talwandi Sabo Power Limited**  
Mansa Talwandi Sabo Road  
Village Banawala

Distt. Mansa (Punjab)  
Phone 01659-248034

- b. The bid shall be submitted in two separate sealed covers
  - a Envelope No. 1 shall contain -
    - i Originally signed copy of the declaration notice
    - ii Bidder's organization chart including the competency details for complete O & M work for the Plant as per the scope in this agreement.
    - iii Bidder's technical/commercial proposal for providing tools and tackles, Manpower, machinery, consumables, spares, etc. to be supplied by the Contractors for fulfilling his obligation to complete the reservoir work.
  - b Envelope No. 2 containing the following: -
    - i Price schedule in the prescribed Proforma as per BOQ.

1.13. The bids, complete in all respects should be received by 29 May 2018.

1.14. Evaluation Criteria :- The bid will be evaluated on the basis of the following criteria: -

- a. Bidders quality of technical/commercial offer for providing relevant services
- b. Bidder's price proposal.
- c. Bidder's past performance in HSE (Health, Safety and Environment)
- d. ISO14001:2004, ISO 9001:2008, OHSAS 18001:2007 or equivalent IMS certifications

Firstly, envelope No.1 containing the technical/ commercial bids will be opened. Envelope No. 2 containing price bid will be opened only after bringing technical/ commercial offers at par after receipt of written clarifications/ discussions.

1.15. **Non-Negotiable GENERAL CONDITIONS OF CONTRACT**

a) **Earnest Money deposit:-**

Party will have to submit EMD of 5 lacs value along with price bid in the form of DD or bank guarantee in favour of M/S Talwandi Sabo Power Limited.

b) **Payment Terms**

- 80% payment shall be released against monthly progressive bills duly certified by TSPL EIC
- 10% of the monthly retention shall be released on completion certification by TSPL EIC and handover.

1.1. Handover includes service building complete in all manner as per detailed specifications, as built drawings, lawn, electrical, lighting and lightening, IT/LAN, fire-fighting alarm system, STP, other infras-car parking, connecting road, etc.

- Remaining 10% of the monthly retention shall be released on completion of work, certification by TSPL EIC and submission of PBG of equivalent value with validity of warranty period with claim period of 6 months post expiry.

c) **SECURITY DEPOSIT AND BANK GUARANTEES**

The Security Deposit in the form of Bank Guarantee in TSPL's format amounting to 10% (ten percent) of the Contract Price shall be submitted within 15 days of effective date. The said bank Guarantee shall be valid for one year and renewed 1 month prior to the end of that year in case of continuing contract or at the instance of owner.

All Bank Guarantees furnished by the Contractor shall be unconditional, irrevocable and from a first class bank of repute acceptable to the Owner.

All the Bank Guarantees shall have a claim period of 6 (Six) months from the date of expiry and shall be extended at the instance of the Owner, if required. However, in case reasons are not attributable to contractor extension will be considered with mutual agreement.

**Attachments:-**

- **Appendix A - Declaration**
- **Appendix B - PBG Format**
- **Appendix C – BG Format for EMD**
- **Annexure A- Scope of Work**
- **Annexure B- Technical Specification- Structural**
- **Annexure C- Technical Specification- Architectural**
- **Annexure D- Technical Specification- PHE**
- **Annexure D- Technical Specification- Electrical**
- **Drawing – Ground Floor**
- **Drawing – First Floor**
- **Drawing – Second Floor**
- **GTCs**
- **STCs**

## Appendix A - Declaration

I Mr/Ms. \_\_\_\_\_, the undersigned, a duly authorize Officer/ Representative of (Company/ Consortium) do hereby declare and state the following:

- 1) We have read this request for proposal for Reservoir construction document in its entirety.
- 2) We have followed the instructions specified in this document while preparing the proposal.
- 3) We assume full responsibility and liability in utilizing and adopting any of the information and assumptions provided in this document.
- 4) We rescind our right to raise any exceptions in future beyond those documented in our proposal to any and all of the terms and conditions stipulated in this document
- 5) Our offer shall remain valid for a period of ninety (90) days from the last date of submission of the offer i.e. \_\_\_\_\_

Signed: \_\_\_\_\_

Date : \_\_\_\_\_

Full Name: \_\_\_\_\_

Designation: \_\_\_\_\_

(Company seal)

## Appendix B - Performance Bank Guarantee

**Date :**

Guarantee No. :

To

Talwandi Sabo Power Limited

Village Banwala,

Mansa-Talwandi Sabo Road,

Distt. Mansa, Punjab-151302

India

Dear Sir,

WHEREAS, \_\_\_\_\_, a company incorporated under the laws of \_\_\_\_\_ and having its registered / principal office at \_\_\_\_\_ (hereinafter referred to as the "Party" which expressions shall include its successors and assigns) has in terms of LOI No/ Contract No. \_\_\_\_\_ dated \_\_\_\_\_ (hereinafter referred as the "Contract") entered between you and the said Party, contracted to supply the good or perform the works and services as stated in the Contract.

AND WHEREAS, as per provision of the said Contract, the Party is required to furnish to you a Bank Guarantee for \_\_\_\_\_ (Rupees \_\_\_\_\_ only) towards due and faithful performance of the Party's obligations under the Contract.

Now, we \_\_\_\_\_ (name of the bank, branch) at \_\_\_\_\_ (address) ( which include our successors and assigns) hereby irrevocably and unconditionally agree and undertake as follows :

1. We hereby irrevocably and unconditionally guarantee to pay to you the sum in aggregate not exceeding \_\_\_\_\_ (Rupees \_\_\_\_\_ only), without demur, merely on the first written demand signed by your representative stating that the amount claimed is due by reasons of breach by the said Party of any of the terms or conditions contained in the said Contract or by reasons of the Party's failure in performance of the Contract and / or any other agreement, if any. Any such demand made on us shall be conclusive as regards the amount due and payable to you by us under this guarantee.

2. Notwithstanding anything to the contrary, your decision as to whether the Party has made any such default or defaults under the aforesaid Contract and / or any other agreement, if any and the amount or amounts to which you are entitled by reason thereof, will be binding on us and we shall not be entitled to ask you to establish your claim or claims under this guarantee and / or be concerned with any dispute, if any between you and the Party and / or refer to the Party and / or rely upon any communication of the Party, but will pay forthwith the sum demanded by you on first written demand without any protest or demur.
3. This guarantee shall come into force from the date of issue of this guarantee and shall remain in full force and effect up to and including \_\_\_\_\_. Should it be necessary to extend the validity of this guarantee beyond the said date, we undertake to extend the period of the guarantee on your request till such time as may be mutually agreed between you and the Party.
4. We further agree that you shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract and all other written agreement, if any relating to the Contract and/or to extend the time for performance by the Party from time to time.
5. Notwithstanding anything contained hereinabove our liability under this guarantee is restricted to \_\_\_\_\_ (Rupees \_\_\_\_\_ only). Unless a claim in writing is lodged with us within a period of 6 (six) months from the date of expiry of the guarantee i.e. up to and including \_\_\_\_\_ or up to an extended date as per clause 3 hereinabove, unless otherwise extended, all your rights under this guarantee shall stand forfeited and we shall be released and discharged from all liabilities under this guarantee whether or not this document shall have been returned to us.

THIS GUARANTEE SHALL BE SUBJECT TO THE LAWS OF INDIA AND THE JURISDICTION OF THE COURTS IN MANSANA, PUNJAB, INDIA

SIGNED AND DELIVERED this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

For and on behalf of

Bank :

Address :

\_\_\_\_\_  
(AUTHORISED SIGNATORY OF BANK) \_\_\_\_\_



APPENDIX C - BG FOR EARNEST MONEY DEPOSIT

M/ s. Talwandi Sabo Power Limited

(1980 MW Power Plant) Village- Banwala,

Mansa-Talwandi Sabo Road, Distt. Mansa,

Punjab. Dear Sirs,

Guarantee No. \_\_\_\_\_ Amount of Guarantee: Rs \_\_\_\_\_

Guarantee cover from:..... To .....

The undersigned, ..... constituted under the .....having its Head Office at ..... and amongst other places a Branch, at ..... (hereinafter called "the Bank") taking into consideration that M/s. ....with its Registered Office at.....(hereinafter called the "Bidder"), have received a tender enquiry for \_\_\_\_\_ for Talwandi Sabo Power Limited, Gram-Banwala Distt-Mansa (Punjab) (hereinafter called the "Principals").

That the Principals are prepared to consider the offer of the Bidder provided the offer is accompanied by a Bank Guarantee for an amount of ` ...../- towards Earnest Money Deposit.

DECLARES:

Hereby to Guarantee irrevocably up to a maximum amount of ..... the due fulfillments by the Bidder of their obligations in this regards, and consequently undertakes to pay, without demur, reservations, recourse, contest or protest and/ or without any reference to the Bidder, to Principals on their first written demand (signed by a Associate General Manager of the Company with date and amount in ` ) all that which the Principals declare that Bidder are due to them in this respect, such with due observance of the maximum amount.

The liability of the bank will arise only if a letter from the Principals stating non-fulfillment

by the Bidder of their obligation is received by the bank on or before .....

The bank shall not be released of its obligations under these presents by any exercise by the Principals of its liberty with reference to matters aforesaid or any of them or by reason of any other act of forbearance or other acts of omission or commission on the part of the Principals or any other indulgence shown by the Principals or by any other matter or things whatsoever which under law would, but for this provision, have the effect of relieving the bank.

The Bank also agrees that the Principals at its opinion shall be entitled to enforce this Guarantee against the Bank as a Principal debtor, in the first instance without proceeding against the Bidder, notwithstanding any security or other Guarantee that the Principal may have in relation to the Bidders liabilities.

This Guarantee comes into force from the date of this Guarantee and will remain valid up to .....and, so that claims, if any, must have been received latest by the undersigned on ..... at the Bank's Office at Mansa.

This Guarantee is not negotiable or assignable.

Please return this Guarantee to us for cancellation on expiry.

Notwithstanding anything herein contained, our liability under this guarantee shall:

1. Our liability under this Guarantee is restricted to ` .....
2. Guarantee shall be valid up to .....
3. We are liable to pay the guaranteed amount or any part thereof towards full & final settlement of our liability under this Bank Guarantee only and only if you serve upon us a written claim or demand on or before the date of expiry of this Guarantee.

Dated at Mansa \_\_\_\_\_ day of \_\_\_\_\_, 20XX.



## **Construction of Service Building**

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### **SCOPE OF WORK FOR CONSTRUCTION OF SERVICE BUILDING AT TALWANDI SABO POWER LIMITED, MANSA**

#### **1.1 Brief Scope of Work:**

The brief scope of work comprises of, but not limited to, the following:

Construction of a RCC building for the purpose of Service building(Office) with 2 storeyed in Ground floor + first floor + Dining facility at 2<sup>nd</sup> floor -model of built up area of 1600 SqM and with all other associated works with the Building like External Development, car parking, rest shed, connecting Road & drains, landscaping & lawn, electrical, Fire protection, lighting, Foundation, other ancillary civil works, etc as per the details of Appendix-1, Schedule -A1, A2,A3,A4,A5 ,A6 , A7& A8 for schedule of works with brief technical specifications and Annexure-B,C,D& E for detailed specifications.

Bidders are requested to submit their most competitive bid offer for carrying out the work set out with reasonable time schedule & proposed floor wise GA drawing & filled in Schedule- A1 to A7.

The brief scope of work under this contract is defined as construction of Service Building at Talwandi Sabo Power Limited, Mansa, Punjab with facilities as per enclosed schedule, Appendix & detailed specifications with all Civil, architectural, Electrical & PHE Works; TSPL has provided floor wise layout plan drawings for bidding purpose; Contractor's Scope shall cover preparation of detailed layout, GA drawings , Structural study report (STAD) , Design Basis Report for approvals from TSPL as per Appendix-1. Scope shall cover the complete building with all interior /exterior civil/ structural works , Architectural works, carpentry as per Appendix-1 ,flooring, tiling, Aluminium type false ceiling, painting, sanitary facilities with STP, electrical wiring, cabling, Distribution panel, UPS, Building Lightning protection system ,Centralised air conditioning system including Ducting, PA system , fire alarm/ fighting system with approvals from TAC, CCTV (IP based & LAN connected) , LAN/ IT network , connecting RCC road & drain (for 100M length &7 M wide) , 2M wide paver block pathway (for 200M) , PCC paved car shed , lawn development..

The work to be performed under this specification consists of planning, design, engineering and construction including providing all labour, materials, consumables, equipment, temporary works, temporary labour and staff colony, constructional plant, fuel supply, transportation and all incidental works not shown or specified but reasonably implied or necessary for the completion and proper functioning of the building, all in strict accordance with the specifications, including revisions and amendments thereto as may be required during the execution of the work.

All materials including cement, reinforcement steel and structural steel shall be arranged by the contractor to accomplish the facility.

The scope shall also include setting up by the contractor a complete testing laboratory in the field to carry out all relevant tests required for the civil works for the project.

The work shall be carried out according to the design/drawings to be developed by

## **Construction of Service Building**

the contractor and approved by the OWNER. For complete building , structures, foundations, etc., necessary layout and design & architectural details & 3D models are to be developed by the contractor keeping in view the statutory & functional requirements of the service building and facilities and providing enough space and access for easy operation, use and maintenance. Contractor's offer shall cover the complete requirements as per the best prevailing practices and to the complete satisfaction of the OWNER.

It is declared that Contractor has inspected the site, examined and obtained all information required to satisfy himself regarding matters and things such as access to site, communications, transport, right of way, the type and number of equipment and facilities required for the work, availability of local labour, materials and their rates, local working conditions, weather, rain/flood levels, subsoil conditions, natural drainage, etc. Ignorance of the site conditions shall not be accepted by the Owner as basis for any claim for compensation or extension of time. The submission of bid by the BIDDER will be construed as evidence that such an examination was made and any later claims / disputes in regard to price quoted shall not be entertained or considered by the OWNER on account of ignorance of prevailing site conditions.

### **1.2 STATUTORY REQUIREMENT**

CONTRACTOR shall comply with all the latest applicable statutory rules pertaining to Factory act, mining department , electrical Inspectorate, PF rules, Fire safety rule of Tariff Advisory Committee (TAC) of IRDA India / NFPA, Water act for Pollution control Board, Explosives act etc and also state mining department latest rules regarding STP & royalty. Provisions of Safety, health and welfare according to Factories act shall also be complied with. CONTRACTOR shall obtain approval of Civil / Architectural / fire alarm detection & fighting drawings from concerned authorities- Factory inspectorate , TAC etc.

### **1.3 DOCUMENTS TO BE SUBMITTED BY CONTRACTOR AFTER THE AWARD OF CONTRACT FOR APPROVAL FROM OWNER**

The following documents are to be submitted for the approval of the OWNER, prior to commencement of fabrication & erection / construction. All drawings shall be of standard sizes (Metric system) and shall be made on latest version of AUTOCAD or AUTODESK . The list is not exhaustive but indicative only.

- General plant layout drawing with co-ordinates
- Drawing showing underground facilities with co-ordinates of these facilities like buried pipes, buried cables, trenches, ducts, sewer, drains, sumps, pits, culverts, foundations etc.
- Geotechnical investigation report based on additional geotechnical investigation carried out by CONTRACTOR along with foundation recommendation.
- Topographical survey drawings along with location and details of Bench mark, grid and boundary pillars based on detailed survey conducted after the award of work.
- Architectural floor plans, elevations, cross sections and perspective view in colour of all buildings. 3D model of building interior & exterior architectural details to be submitted for approval.
- Design calculations and drawings for foundations / substructure and superstructure of building
- False ceiling general arrangement drawings
- Illumination study & detailed lighting layout shall be submitted with below concept:

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All working area inside building shall have average illumination level in LUX as 400, non studying areas like kitchen, canteen, stores, documentation room , toilet shall have LUX level of 150-200; Outdoor / landscaping, road way , pathways shall have LUX level of 15-20 .

- Total quantity of concrete (grade wise), reinforcement steel (diameter wise) and structural steel (section wise) in all construction drawings.
- Construction and erection procedure for all major structures. The erection scheme shall be indicated in the design drawings.
- Quality assurance and Quality Control procedures.
- Fire alarm/ protection drawings in line with TAC norms
- Piping layout inside building (Potable , hydrant & sewage)

### **1.4 CONSTRUCTION WATER**

Construction water shall be provided by OWNER at a suitable location identified during execution stage at free of cost. All other Cost of all connected works such as but not limited to intake structure / bore wells, pumps, pipeline, ground water reservoir etc. are to be borne by the CONTRACTOR.

### **1.5 CONSTRUCTION POWER**

Construction power will be made available by owner at a single point 415V level at a maximum distance of 600M. Further extension of the power line to the various locations as required shall be executed by the CONTRACTOR at his cost. No energy charges for construction works shall be levied to contractor by owner. CONTRACTOR shall make provision of D.G. sets as standby power source. This is especially essential for uninterrupted concreting works etc.

### **1.6 TEMPORARY SITE BUILDING & STORES**

The CONTRACTOR shall provide at his cost the following building facilities for proper execution and quality control of the job, while meeting the provision stipulated by Factory Rules regarding staff welfare facilities. All these buildings shall have brick cladding; colour coated steel sheet roofing over steel roof truss with cement concrete flooring and false ceiling.

A covered store shall be provided with brick cladding / colour coated steel sheeting to store at least one month requirement of cement. Cement in bags shall be stored on a raised floor well away from outer walls and insulated from the floor to avoid moisture. Not more than 15 bags shall be stacked in any tier. Each consignment of cement shall be stored separately and consumed in its order of receipt.

Covered storage area may also be provided to store other construction material which will be affected on exposure to wind, sun and rain. Reinforcement shall be stacked on top of timber sleepers to avoid contact with ground / water.

Proper security arrangement shall be provided by contractor for their office & stores complex.

### **1.7 STAFF WELFARE FACILITY**

CONTRACTOR shall provide adequate facility for his staff/labour inside the plant

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boundary such as canteen, drinking water facility, rest places, crèches etc. Contractor shall identify and arrange sufficient labour colony outside the plant boundary to locate their staff and labour colony.

### **1.8 Seismic Load**

Project falls in seismic Zone-III. Criteria for design shall be as governed by Part-1 and Part-4 of IS: 1893. Importance factor for all structures shall be taken as per IS 1893: Part 4.

### **1.9 STABILITY OF STRUCTURES**

Service building sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combination of loads. Factor of safety for these cases shall be taken as mentioned in IS: 456 and other latest relevant IS codes. However following minimum factor of safety shall be followed:

- a) Factor of safety against overturning due to wind, seismic or other lateral load shall be 1.4 minimum
- b) Factor of safety against sliding shall be 1.4 minimum
- c) Factor of safety against uplift due to hydrostatic forces shall be 1.2 and due to any other loads shall be 1.5.

### **2.1 Masonry Works :**

Providing & Construction of 230mm Brk with CM 1:6 and 115 thk Brk wall in CM 1:4 at all lead and lifts at all levels as directed by the engineer in charge.

### **2.2 Plastering Works :**

Providing & Applying of 20mm thk Sponge finish External Plastering to walls ,12mm thk plaster for internal walls ,10mm thk Rough plaster for receiving the tile work in CM 1:6 and 15mm thk duct plaster in CM 1:6 at all leads and lifts as directed by the Engineer in charge .

### **2.3 Flooring Works.**

Providing & Laying of glazed Ceramic/Vitrified tiles and Kota/Flamed granite stone Flooring set on 20mm thk CM 1:4 of approved makes at all leads and lifts as directed by the Engineer in charge.

### **2.4 Dado/Cladding Works.**

Providing & laying of glazed tile dado of approved pattern over 6-10 mm tile adhesive as per the instructions of engineer in charge. Providing & laying Of Dry Cladding in Lalitpur yellow/grey stone with non –ferrous anchorage with HILTI, stainless steel clamps and dowels etc

### **2.5 Painting Works.**

Providing & Applying of Acrylic Emulsion Paint of approved makes for ceiling and walls with 2 coats of Birla white putty +1 coat of Web based primer+2 coats of emulsion Paint at all levels as directed by the Engineer in charge.

External walls : providing and applying of Weather proof cement paint and Apex fine finish All as per the instructions of the engineer in charge.

### **2.6 Doors and Joineries**

Providing & fixing of Wooden door/Window frames in Malasian Salwood finished with two coats of

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Enamel paint. Flush shutter 35mm thk finished with Enamel Paint on both sides for doors.

### **2.7 Aluminium Doors and Windows.**

Providing & Fixing Powder coated Aluminium Framed windows/Ventilators/Doors of Hindalco /Jindal with options of openable/fixed glazing in 6mm thk Clear glass as per the instructions of the Engineer in charge. All Windows shall be openable/ lockable from inside the building and shall be provided with aluminium grills outside with greater aesthetic look

### **2.8 Architectural Finishing Works :**

Supply and installation of Glazing cum door units with Aluminium Frame systems of Hindalco/Jindal all as directed. supply and fixing of ACP cladding as per the details given in the drawings.

2.9 **Miscellaneous Other works** mentioned below shall also be executed by contractor:

- Car parking facility with M20 grade paving with shed- for 15 No. vehicles
- Car parking facility with M20 grade paving without shed- for 20 No. vehicles
- Centralised Air condition with all accessories/ ducting for complete building
- Sewage treatment plant preferably with natural Reed bed technology designed for 110 Personnel
- Suitable Front Lawn , Landscaping with decorative lighting- for150 SqM
- Connecting M30 grade 7M wide RCC Road & side drains- 100 M
- 2M wide paver block pathway -100M
- Semi open type Rest Shed (6X4M) with sitting arrangement for 10 personnel
- Façade at the entrance of the building with a vehicle access
- 2nd Emergency exit in each floor to be considered
- Hydrant point provision at building 2 Nos per floor with fire hose with hose box as per standards; Terminal point shall be at nearby plant hydrant line located approximately at a distance of 400-500M.
- Potable water shall be tapped from nearby plant potable water line at an approximate distance of 400 M using 80NB MS pipeline .
- Biometric based access control on all the entry door points of the building beyond visiting lounge & CCTV cameras at essential locations. High definition 360Degree CCTV camera (10 Nos) with all accessories, networking, hardware and software required for interfacing with existing CCTV network (all cameras shall be of IP based & accessible on http protocol)
  - i. Outdoor (3Nos) Make- Bosch, Type- PTZ (Pan, Tilt -360Deg , Zoom ), Auto Dome IP STARLIGHT 7000 HD, Protocol- http based
  - ii. Indoor (7 Nos) Make- Bosch, Type- Flexi Dome, Indoor 4000HD & Protocol- http based

### **3.0 Electrical Works:**

Design, layout drawings preparation , Supply & erection, installation , testing and commissioning of all electrical items of work for internal/ infrastructure installation works including main power distribution panel, lighting distribution panel, AC/ heater, geaser distribution panels with required ELCB/ MCB/ wiring/ cabling, cabling and conducting, lighting, lightning protections for building, Earth pits separately for grid and electronic earth pits for UPS power supply, complete earthing system ,UPS system, IT fibre optic/ LAN networking with LIU switches for all work stations, cubicles & rooms, PA system, Fire alarm& protection system ,centralised air conditioning system with complete ducting, air handling

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units, chiller units etc , 3 number industrial type RO water purifier system of 50 LPH capacity and other related works .The scope includes testing, commissioning and handing over.

Terminal point for Power supply shall be at 415V level TSPL MCC/ Switchgear panel located at TG building and contractor shall lay 2 runs of 3.5 Core X 300 Sqmm armoured aluminium LT power cable for approximately 500M route length (total interconnection cable is 1000M).

Terminal point for IT networking shall be from nearby plant IT point approximately at 300- 500M ; Party to lay fibre cable with splicing arrangements upto service building & to provide all required LIU / interface switches of CISCO make for further LAN distribution to all work stations, cubicles & rooms.

Terminal point for fire alarm & fire protection system shall at CCR room. Contractor shall lay cable of 2 Runs of 3cX1.5 Sqmm LT armoured control cable from CCR to Service building which shall have approximately 500M route length to interface with existing fire alarm server at CCR of GE- Edwards make. contractor shall provide the complete fire detection & alarm system with fire alarm panel of GE- Edwards make at service building as per TAC norms.

### **4.0 PHE Works:**

Supply & installation of Sanitary Fixtures, Internal & External sewerage system connecting to STP, External storm water drainage system connecting to nearby plant storm drain , domestic water supply system, Rain water system etc.

.The scope includes testing, commissioning and handing over the work in all aspects as directed by the Engineer in charge.



Annexure-B

Technical Specifications For Structural Works

**STRUCTURAL - INDEX**

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## **SECTION - EXCAVATION (A – EXV)**

### **SITE WORK**

#### **1.00 Subsurface Investigation**

##### **1.01 General**

Contractor shall be deemed to have visited the site prior to submitting his Bid and made all necessary inspection and investigations and to have decided for himself the means of access and working space, the nature of the ground and subsoil, if any, level of water table, extent of rock demolitions, support of neighboring properties, etc.

##### **1.02 Related work**

- a) Clearing, grubbing, removing all vegetation from the site.
- b) Excavation including getting out.
- c) Filling and back filling.
- d) Compaction of fills.
- e) Removal and disposal of surplus material.

The contractor shall provide all labours, equipment, materials and any incidentals necessary to complete all aspects of work included in the drawings and specifications.

#### **2.00 Site Preparation**

##### **2.01 Site Inspection:**

Any Site details or site information included in the contract documents or bid Drawings are provided for the Contractor's guidance only. The information provided may not be a complete or accurate description of conditions existing below the surface of the ground. The correctness of the information is not guaranteed and the contractor shall be responsible to make its own interpretation of sub-surface conditions.

The contractor shall visit the site, examine the boreholes, and decide for himself the nature of the ground and the subsoil to be excavated. No claim for extra payment will be entertained because of any misunderstanding, incorrect information, assumptions, or ignorance of existing conditions.

##### **2.02 Applicable Standards**

The following standards shall be followed:

- a. IS: 3764-1966 Safety Code for Excavation Work.

- b.IS: 1498-1970 Classification and identification of soils for general engineering purposes.
- c. British Standard 1377-Methods of test for Soils for Civil Engineering Purposes.
- d. British Standard 5930- Code of Practice for Site Investigations.
- e. Local Building Regulations and Statutory Regulations.

### **2.03 Definitions**

**Clear:** The removal of trees, scrub and artificial obstructions including fences, concrete slabs, kerb and channel, remains of old buildings and the like.

**Grub :** The removal of tree stumps and roots.

**Topsoil:** Topsoil is all surface soils, which have sufficient humus to support plant growth without resort to artificial fertilization.

**Cut:** A general term for ‘in place’ material removed by digging from the ground. The term ‘excavation’ or derivatives thereof may be used interchangeably.

**Fill:** A general term for material spread and compacted over the ground to make up finished levels or levels to sub-grade. The term ‘Embankment’ or derivatives thereof may be used interchangeably.

**Sub-Grade:** The finished, trimmed and prepared surface of the earth works after completion of all cut and fills operations. The term ‘formation level’ or derivatives thereof may be used interchangeably.

**Sub-Base:** A selected filling layer spread and compacted over the sub-grade to make up levels to the underside of the base course or floor slab.

**Base course:** A selected filling layer spread and compacted to levels immediately below road wearing course.

**Spoil:** Excess cut material remaining at the end of filling operations.

**Bulk Earthworks:** Earthworks to create, by excavation and/or filling and compacting, building platforms, road formations, parking areas, reservoir, embankments, drainage canals or any other formation where the unimpeded use of large earthmoving equipment is possible. This is distinct from backfill of trenches, foundations or other earthworks immediately adjacent to completed or partially completed structures.

### **2.04 Site Quality Control**

The contractor shall provide in his quality assurance programme information to show that a system will be used to ensure that all works carried out under this sections (including any done by subcontractor) will comply with all the requirements of this section.

### **3.00 Antiquities**

Any ancient carvings, relics, coins or other curiosities discovered during the excavation or other work shall remain the property of the owner and shall be handed over to the owner as required under the General Conditions of contract.

### **4.00 Verification of Ground Levels**

Ground level information is provided on the drawings. The contractor shall inspect the site and satisfy himself that this information is a true representation of existing ground levels. If he carries out additional survey work, which proves some major differences, he shall advise the Project Manager accordingly.

### **5.00 Benchmarks and Setting Out**

The Owners has established two permanent benchmarks on the site. One of these will provide both vertical and horizontal data and the second horizontal data only.

The contractor shall engage a qualified surveyor to establish other permanent benchmarks in suitable locations around the site. These benchmarks shall enable the contractor to set out the location of all buildings, paths, roads, utility lines, swales and all other portions of the Contract work. For example, a benchmark located adjacent to the site of a proposed building will enable levels to be transferred so that the design levels of floors can be achieved within the tolerances given on the Drawings.

If an error in setting out causes some portion of the work to be constructed in the wrong location, or to the wrong dimensions, the contractor shall make good the incorrect work at his own expense to the satisfaction of the Project Manager. The contractor shall be liable for any consequential loss incurred.

### **6.00 Excavation Classification**

- a) Excavate foundation over the Project Site from existing ground level to the formation levels shown in drawing.
- b) Excavation to pit working level.
- c) Earthworks outside property line.
- d) Excavation, compaction and backfill to plinth and service trenches.

#### **6.01 Related Works**

- a) Site Preparation
- b) Dewatering
- c) Cast-in-Place Concrete

#### **6.02 Definition**

- a) Structural excavation: Excavations for concrete foundations.
- b) General fill: Filling required for earthwork other than structural fill.
- c) Structural fill: Filling under structures and to foundation trenches.
- d) Rock, which is in solid beds, which can only be removed either by blasting or by wedging or chiseling, shall be treated as hard rock. A boulder or detached rock measuring one cubic metre or more shall also be treated as hard rock if the same cannot be removed without blasting, wedging or chiseling.
- e) A boulder or detached rock measuring less than one cubic metre shall be treated as soft rock which may require wedging or chiseling or even if the contractor opts for blasting.

#### **6.03 Measurements**

In case of soft rock and hard rock, the excavated stuff shall be properly stacked or disposed off in places as directed. The quantity of these stacks shall be measured and payment will be based on the net quantities after deducting voids from the measured quantities as per table below.

Soft rock 35%

Hard rock 40%

Or as per theoretical measurement of the pits from the premeasured levels of surface taken prior to commencement of rock excavation whichever is lower.

**6.04 Blasting /excavation in hard rock**

1. When blasting operations are considered necessary, the contractors shall intimate about the same and shall obtain license from District/Public authorities for carrying out blasting work as well as for obtaining, transporting and storing explosives as per 'Explosive Rules 1940' or as amended.

2. Blasting operations shall be carried out under the supervision of a responsible licensed operator of the contractor during certain specified hours preferably during lunch break 'on approved in writing.' The operator shall be conversant with the rules of blasting. The operator should have the valid blasting license.

**6.05 The material involved in earthwork shall be classed as follows:**

a) Soils: Material such as sand, gravel, loam, clay, mud, black cotton, moorum, shingle, river or nullah bed boulders, disintegrated rock, soling of roads, paths, hardcore, macadam surface of any description (water bound, routed tarmac etc.) lime concrete mud concrete or any combination of these. This class of material will yield to the application of picks, shovels, or any other manual digging implements.

b) Ordinary Rock: (Soft rock) Material such as limestone, sand stone, laterite, hard conglomerate. This is any material that will not yield to manual implements, but is capable of being excavated by conventional earthmoving plant applicable to the site and the distances that material has to be moved. The use of a pusher unit or small crawler tractor with ripper to facilitate excavation shall be considered as part of conventional plant.

The contractor may with the written permission of the Project Manager resort to a small amount of blasting to loosen any of this material but this action will not in any way entitle the material to be classified as 'Hard Rock'.

c) Hard Rock: Any rock or boulder the excavation of which requires blasting. Such materials include quartzite, granite, basalt, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) located below ground level.

d) Hard Rock (blasting prohibited): Hard rock as described at c) above but where the blasting is prohibited for any reason and excavation has to be carried out by chiseling. Wedging or any other method agreed to by the Project Manager.

**7.00 Earthwork General****7.01 Clearing**

a) Access

Clear areas required for access to site and execution of work.

b) Undergrowth

- Clear site of bushes, shrubs and undergrowth without disturbing subsoil.
- Shrub out and dispose of large roots.

c) Waterways:

- Temporarily divert as necessary all field drains and other waterways encountered during the excavations and:
  - If possible, reinstate on completion;
  - If not possible to reinstate, obtain instructions.

**7.02 Protection**

- a) Protect benchmarks from damage or displacement.
- b) Maintain designated site access on the site layout organisation plan(s) for vehicle and pedestrian traffic.

### 7.03 Dewatering (only if required)

- a) Localised deep areas shall be dried during execution of foundation works

#### Execution

- a) Install temporary diversion channels, excavations, embankments, drains, pipes, pumps and the like necessary for dewatering.
- b) Remove temporary works on completion.

## 8.00 Earthwork – Excavation

### 8.01 Nature of Excavation

Include for excavating in any type of ground encountered

## 9.00 Earthwork – Fills

### 9.01 Testing of fill materials:

- a. Tests shall be executed by an independent testing agency.
- b. In executing tests comply with the following IS Standards.
  - a. Sampling
  - b. Sample preparation
  - c. Sieve analysis
  - d. Liquid limits
  - e. Plastic limit and plasticity index
  - f. Moisture content
  - g. Moisture density relationship
  - h. Sand equivalent
  - i. Specific gravity
  - j. Sand core density
  - k. Rubber balloon density
2. Classification
  - a. Carry out moisture density tests on representative samples prior to placing.
  - b. Carry out gradation of materials prior to placing as the work proceeds.
  - c. Carry out site density tests of materials as the work proceeds and as follows:

### 9.02 Frequency of Tests

#### Structural Fill:

1. One test for each 500 Cum. placed.
2. One tests whenever there is a change of gradation or placement conditions.

#### 9.03 General Fill:

1. One test for each 3000 Cum. placed.
2. One tests whenever there is a change of gradation or placement conditions.
3. Execute site density tests for compaction at a minimum depth of 100 mm below compacted surface.
4. Execute a full compaction test or a one-point compaction test in conjunction with each site density determination.

5. Execute a gradation test with each site density test and whenever there is an apparent change in material being placed.

6. Execute the following site density tests and laboratory moisture density tests to evaluate compaction achieved:

(i) One test for every 200-400 cu.m. of backfill in trenches or surrounding structures.

(ii) One test for every full shift of compaction operations on mass earthwork.

#### **9.04 Source of fill material:**

- Obtain fill/murrum from the excavations and/or from suitable off site sources.
- Earth filling in plinth with surplus excavated earth including back filling and consolidating by watering and ramming.

#### **9.05 General and structural fill:**

- To conform to gradation of well graded soil.
- To be free from plastic fines and weakly elemented lumps of sand.
- To be homogeneous and at the optimum moisture content for compaction purposes when placed.

#### **9.06 Crushed stone:**

To consist of either:

- Durable crushed rock comprising angular fragments obtained by breaking and crushing solid or shattered natural rock, or
- Durable crushed gravel stone obtained by artificial crushing of gravel, boulders, or fieldstone.
- Rubble soling 20 cm in height consisting of random granite stone/ available laterite stone including filling in voids with durable crushed rock comprising angular fragments and consolidating with mechanical ramming.

#### **9.07 Water**

- Water used for compacting fill or for washing crushed stone shall be clean and free from oil, grease, organic matter, suspended sediments and other deleterious substances.

#### **9.08 Excavation**

1. Excavate to the depths and profiles shown on the drawings or as directed by the Project Manager.
2. Extra width where necessary for providing working space for further work will be permitted and paid for. Such extra width will be limited to the allowances provided in ISI Code 1200.

#### **9.09 Adjacent excavations:**

- Where an excavation encroaches below a line drawn at an angle of 60 Deg. from the horizontal from the nearest formation level of another higher excavation, the lower excavation, all work within it and backfilling thereto shall be completed before the higher excavation is done.

#### **9.10 Excavated formations:**

1. In made up ground excavate foundations down to a natural bearing formation of undisturbed subsoil, unless otherwise instructed.
2. Obtain instructions if a natural bearing formation of undisturbed subsoil:
  - Is obtained at a lesser depth than shown on the Drawings.
  - Is not obtained at the depth shown on the drawings.



3. If, after inspection, formation becomes unsuitable for any reason, excavate further and backfill with approved material all at the Contractor's expense.

**9.11 Treatment of formations generally:**

1. Trim excavations to required profiles and levels.
2. Remove all loose material.

**9.12 Excess excavation:**

1. Backfill any excavations taken wider or deeper than required with mass concrete.
2. Where such excess excavation is carried out without approval, necessary extra backfilling with mass concrete shall be at the Contractor's expense.

**9.13 Compaction Requirement**

Each layer of filling shall be compacted to and uniformly dense, stable condition in which it does not wave or creep under rolling.

The required compaction of fills which are deemed to be part of bulk earthworks shall be achieved by a minimum number of passes of compaction plant. This plant shall unless the Project Manager specifically allows in writing, include type

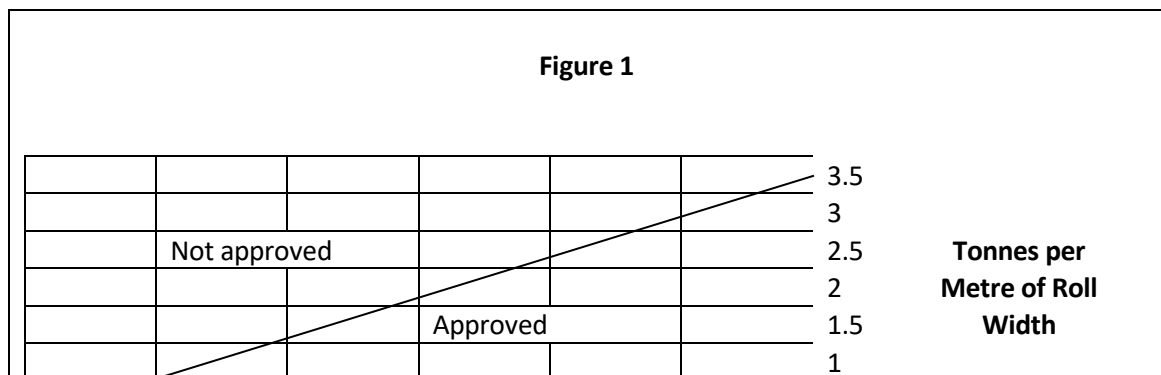
- a) For primary compaction, and may include either or both types.
- b) Of the following listed types for the final compaction of the surface.

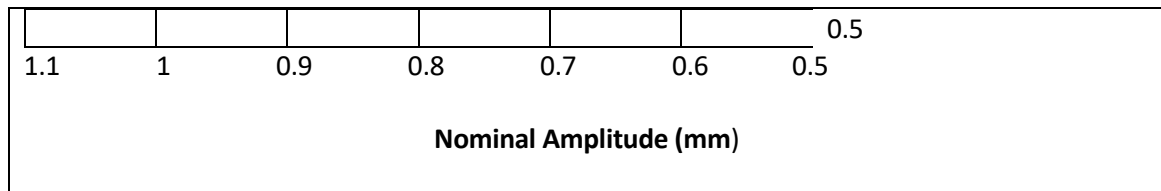
1 Vibratory roller of either double or single vibrating drum of not more than 3.2 tonne mass per metre of roll width having a vibration frequency of not less than 37 Hz. Vibrating roller not exceeding the above weight limit but of frequency less than 37 hz are approved providing the nominal amplitude does not exceed that shown relative to the weight in tones per meter roll width as noted in figure 1. Any other vibrating roller specifically approved by the Project manger may be used. Vibrating rollers of less than

1 tonne per metre of roll width shall not be used to compact any layer of fill of more than 200mm of un-compacted thickness.

2 Three wheel steel- tired rollers having rear rolls each at least 0.50m wide and having not less than 4.5 tonne per metre of roll width.

3 Pneumatic tyred roller having a minimum weight when operating of not less than seven tonne, spread over at least seven pneumatic tyred wheels.





For filling in inaccessible places or against structures, hand tamping or small vibratory compaction equipment may be used with the approval of the Project Manager.

Care must be taken during compaction to ensure that no gaps are formed between adjacent layers.

Fill material shall be compacted to attain the densities as called for in the specifications.

As filling proceeds, test to verify the compaction being achieved shall be conducted. Tests shall be done at a minimum frequency no less than one test per 150 cum. of fill volume. Testing locations shall be distributed evenly throughout the fill volume and each layer area. The locations shall be to the satisfaction of the Project Manager and copies of the results of all tests shall be submitted to them whether successful or not.

In the event that tests do not verify the minimum compaction requirements, the whole of the area for which the test is representative shall be reworked and retested, unless otherwise directed by the Project Manager.

Where the Project Manager is of the opinion that a specific area within an embankment cannot get compacted to the specified density, he shall order alternative improvement works.

The following references shall be used to confirm compliance:

Sampling	BS 5930 (or as updated), IS 2720
Field Dry Density:	BS 1377: 1975 Clause 4.4 Test 15 (or as updated)
“Determination of the dry density of soil on the site – Sand replacement test”	
Standard Maximum	BS 1377: 1975 Clause 4.1 Test 12 (or as updated)
Dry Density:	“Determination of dry density / moisture content relationship”
using 2. Kg rammer	
Moisture Content:	BS 1377: 1975 Clause 2.1 Test 1 (or as updated)
	‘Determination of the moisture content – Standard”

1. Remove all suitable and excess material from areas to be filled.
2. Surface of ground with a gradient exceeding 1 in 5, which is to receive filling must have horizontal benches cut to match the depths of compacted layers of filling.
3. Do not place fill until the formation has been inspected by the Project Manager. Give the Project Manager at least 24 hours notice of when formations will be ready for inspection.

**9.14 General filling:**

1. Deposit in horizontal layers not exceeding 200 mm thick before compaction. Compaction tests for proctor density to be taken at every 2 layers for each area of 100 sqm or less.

2. Where material is dry, wet each layer to its optimum moisture content for compaction purposes.
3. Where material is wet, delay compaction and placement of additional fill until optimum moisture content is attained.

**9.15 Structural filling:**

1. Deposit in horizontal layers not exceeding 200 mm thick before compaction.
2. Each layer shall be uniformly moist and at the optimum moisture content for compaction purposes.

**9.16 Crushed stone:**

1. Deposit in horizontal layers not exceeding 200 mm thick.
2. Deposit material so that it is free from lenses, pockets, streaks and other imperfections.
3. Consolidate using hand tamping, vibratory tampers or other approved methods.

**9.17 Proof Rolling under Fill Embankments**

After removal of topsoil, the existing natural ground that will be under fill embankments shall be scarified to a depth of not less than 150mm and compacted so that the criteria called for on the specification are met.

**9.18 COMPACTION**

**General (Filling):**

1. Compact filling after grading and leveling surfaces.
2. Compact filling in layers, adding any necessary extra fill and water, to attain the minimum dry densities as tabulated in the table appended at the end of this Section.
3. The Project Manager will inspect each layer of fill after compaction. Do not place further layers without approval.
4. Compact filling using vibratory plate, roller or other approved equipment, making the required number of passes with the equipment to obtain specified densities. Each trip of equipment shall overlap the previous trip by 500 mm.
5. Confine compaction operations to areas adequate in size for establishing an orderly pattern of compaction.

**Final grading:**

1. Grade the top surface of filling after compaction to give a uniform surface within specified tolerances.

**SCHEDULES**

**Curve No. 1:** See Table at the end of this Section.

**Table for compaction requirements:**

<b>Fill Materials</b>	<b>Min. Passes</b>	<b>Min. Energy*</b>	<b>Min. Compaction</b>
General Fill	3	4550 Kg	90%
<b>Structural Fill:</b>			
Confined spaces	4	1150 Kg	95%
Open spaces	3	4450 Kg	95%
<b>Crushed stone:</b>			
Confined spaces	4	1150 Kg	-
Open spaces	3	4450 Kg	-
Catch	3	4450 Kg	95%

**Notes:**

1. Forces applied for compaction shall be dynamic or impact loads.
2. Specified percentages of compaction shall be related to the maximum dry density at the optimum moisture content as established by and verified on site by.
3. Correct field density to account for stone material larger than 19 mm in accordance with suggested methods.

**SECTION: CONCRETE (A – PCC, A - RCC, A – ST)**

Related Work

- Concrete Form Work
- Concrete Reinforcement
- Cast – in situ Concrete

**i. Quality Assurance**

- a. Supervisory staff shall have qualification and experience in the above field.
- c. IS Standards – Note: Latest amendments shall be followed

IS - 299	Specification for Ordinary, rapid hardening and low heat Portland Cement Specification for Portland blast furnace slag Cement
IS - 455	Specification for Portland pozzolona Cement
IS - 1489	Method of physical tests for hydraulic Cement
IS - 4031	Specification for Standard sand for testing of Cement
IS - 650	Specification for Coarse and Fine aggregate for use in mass concrete
IS - 383	
IS - 515	Specification for natural and manufactured aggregate for use in mass concrete.
IS - 2387	Method of test for aggregates for concrete.
IS - 516	Methods of test for strength of concrete.
IS - 1199	Methods of sampling and analysis of concrete
IS - 3025	Methods of sampling and test (physical and chemical) for water used in industry.
IS - 432	Specification for Mild steel and medium tensile bars and hard drawn steel wire.
IS - 1139	Specification for hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcement.
IS - 1566	Specification for plain hard drawn steel wire fabric for concrete reinforcement
IS - 1785	Specification for plain hard drawn steel wire for prestressed concrete.
IS - 1786	Specification for cold twisted steel high strength deformed bars for concrete reinforcement.
IS - 2080	Specification for high tensile steel bars used in prestressed concrete
IS - 303	Specification for Plywood for general purposes
IS - 4990	Specification for plywood for concrete shuttering work
IS - 1629	Rules for grading of cut size of timber
IS - 2645	Specification for integral cement water proofing compounds

IS - 1791	Specification for batch type concrete mixers
IS - 2438	Specification for roller pan mixer
IS - 2505	Specification for concrete vibrators, immersion type
IS - 2506	Specification for screed board concrete vibrator
IS - 2514	Specification for concrete vibrating tables
IS - 3344	Specification for pan vibrators
IS - 4656	Specification for form vibrators
IS - 2722	Specification for portable swing weigh batchers for concrete (single & double bucket type)
IS - 2750	Specification for steel scaffoldings.
IS - 456	Code of practice for plain and reinforced concrete
IS - 1343	Code of practice for prestressed concrete
IS - 457	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
IS - 3370	Code of practice for concrete (Part I to IV structures for storage of liquids
IS - 3935	Code of practice for composite construction
IS - 3201	Criteria for design and construction of precast concrete trusses.
IS - 2204	Code of practice for construction of reinforced concrete shell roof.
IS - 2210	Criteria for the design of R.C. shell structures and folded plates.
IS - 2751	Code of practice for welding of mild steel structures are folded plates
IS - 2502	Code of practice for bending and fixing of bars for concrete reinforcement
IS - 3558	Code of practice for use of immersion vibrators for consolidating concrete
IS - 3414	Code of practice for design and installation of joints in buildings
IS - 4014	Code of practice for steel tubular, scaffolding
IS - 2571	Code of practice for laying insitu cement concrete flooring

## **1.00 CONCRETE FORMWORK**

### **1.01 Related Work**

- Concrete
- Reinforcement

### **1.02 Section Includes:**

Design, Fabrication, erection and striking of formwork for in - situ concrete

### **1.03 Quality Assurance**

Design and construction shall be executed and supervised by fully qualified personnel.

In accordance with quality assurance programme, the contractor shall provide the Project Manager with information demonstrating that a system will be used to ensure that the work carried out under this section (including that done by sub-contractors) will comply with the requirements of the specifications.

### **1.04 Design Criteria**

Formwork system shall be executed and designed by a specialist qualified to under take such jobs.

- a) Erected Form work shall be watertight, shall conform to shape, lines, dimensions, verticality, rigid during placing, vibrating and configuring the concrete
- b) Formwork system shall be of steel or timber or 12mm thick water resistant Ply board.
- c) Design of formwork shall take into account:
  - Height of pour
  - Thickness of member
  - Rate of pour
  - Concrete slump
  - Texture of finish
  - Placing temperature
  - Concrete density
  - Method of Discharge
- d) Form work design shall have
  - Dimensional tolerance
  - De mountable without shock, disturbance or damage to concrete
- e) Adjustable steel supports and props to full height without joints, with sufficient bracing & shall take into account the construction loads and supported on sole plates and double wedges and shall allow free movement and accessibility under form work
- f) Props of extra ceiling heights shall be specially designed.
- g) All rubbish, drippings, shoring, saw dust shall be removed.
- i) Forms shall be of either Steel sheets, water-resistant Ply boards or timber or as specified by the Project Manager and shall be continuous, straight and without any warping.
- j) Ties shall be provided where required
- k) All shuttering joints shall be taped with plastic faced adhesive tape for getting smooth finished concrete.
- l) Cambers shall be provided where shown

## 2.00 Form Work

Construction formwork with smooth faced plywood, steel or timber to produce smooth straight level and sharp profiles. Panels to be in largest practicable sizes to reduce the number of joints.

- a) Form material shall have strength adequate to withstand pressure of newly placed concrete without excessive and adjustable bow or deflection.
- b) Factory fabricated, adjustable length removable or snap of metal form ties, design to prevent from deflection and to prevent spilling concrete surfaces on removal.
- c) Ties shall be such that
  - A portion remaining within the concrete shall be at least 38mm from the outer concrete surface.
  - That will not leave a hole larger than 25mm dia meter on the concrete surface.
- d) Form coating compound that will not bond with, stain, not adversely effect concrete for required bond or adhesion not hamper the wetting of surface to be covered with water or curing compound.

## 2.01 Execution

- a) Ties passing through concrete shall be positioned as per approval.

- b) Ties remaining in concrete shall have minimum cover.
- c) Supports shall be sufficiently strong to carry the construction safely.
- d) Release agents shall be applied evenly to the face of the formwork, shall avoid contact with reinforcing and cast concrete and construction joints.
- e) Cambers: Unless otherwise shown in the drawings the soffits of beams exceeding 5M spans shall have laid to the following camber.  
Camber =  $\frac{\text{Span}^2}{7200 \times \text{depth}}$  (Where all dimensions are in mm)
- f) Depth of beams at all points in the span shall as indicated.

**2.02 Striking Formwork**

- a. Strike Formwork carefully to avoid sudden shocks from removal of wedges or vibration.
- b. Where finished edges have re entrant angles, remove Formwork as early as possible to avoid shrinkage cracks.
- c. Striking time shall be as follows:

Type of Formwork	Minimum period before striking (Excluding the day of casting)
i. Walls	24 hrs
ii. Columns	24 hrs
iii. Slabs	7 days
iv. Between ribs not more than 1 to 2 m	7 days
v. Ribs, joists, beams, soffits	
- Up 10'-0" clear span - Beams	7 days
- Between 10'-0" to 20'-0"- Beams	14 days
- Above 20'-0" clear span beams	21 days
vi. One way floor slabs - upto 10'-0"	7 days
vii. One way floor slabs - between 10'-0"to 20'-0"	10 days
viii. One way floor slabs - over 20'-0"	14 days

Striking of Formwork within the time limits listed above is subject to successful crushing of tubes compressive strength results. However re-shuttering and re-propping can be done if the required strength is attained as per the instructions of Project Manager.

**2.03 Cleaning and Oiling of Forms**

The contractor shall ensure that the surface of the forms that will touch the concrete shall be free from encrustations of mortar, grout, or other foreign material. Temporary openings shall be left at the bottom of formwork to enable sawdust, shavings, wire off-cuts and other foreign material to be removed from the interior of the forms before the concrete is placed. Compressed air shall be used to clean the complete formwork and remove all traces of duct and debris before pouring concrete the temporary holes shall then be closed.

The surface of the forms to be in contact with the concrete shall be coated with a reliable coating that will effectively prevent the adherence of concrete and will not stain the concrete surfaces. After each use, the

surfaces of forms which have been in contact with concrete shall be cleaned of mortar and any other material sticking to them, then well wetted and treated with form oil approved by the Project Manager.

#### **2.04 Fair Face Finished Concrete**

##### **Scope**

These are additional requirements for fair faced concrete and includes all visible concrete surfaces that are not specified or called for on drawings as plastered, including foundations and edges of slabs on ground.

#### **2.05 Related work**

The contractor shall coordinate the work with masonry, electrical, mechanical, plumbing and other trades.

#### **2.06 Samples**

The contractor shall provide samples of fair face cast in place concrete colour finish showing the limits of colour variation. These shall be kept by the Project Manager for reference.

#### **2.07 Concrete**

The contractor shall ensure that only one brand of cement and only one source for aggregates is used throughout all fair face concrete work unless otherwise approved by the Project Manager. Limits of deleterious materials permissible in aggregates shall be as for aggregates listed in clause 5.2.

#### **2.08 Formwork**

The contractor shall ensure that plywood, metal and other approved panel type material joined to provide continuous, straight, smooth surfaces in the largest possible practical sizes to minimise the number of joints and to conform to the location of movement joints shown on the drawings. Timber is to be finished instead of rough sawn to provide the concrete finish tolerances specified below. Chamfer exposed edges and water drips where shown to produce straight smooth lines and tight edge joints.

Tolerances for irregularities such as fins and offsets in the form finish are 3mm for abrupt changes in level and 5mm over 1500mm for gradual surface irregularities.

#### **2.09 Form Release Agent**

The contractor shall provide commercial form release agent that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

#### **2.10 Form Ties**

Form ties may be used to prevent form deflection. They shall evenly spaced for appearance. Form ties, steel reinforcement and tie wire to have sufficient cover as called for in clause 7.10 to prevent any spilling of concrete. The contractor shall provide form ties that, when removed will not leave holes larger than 25mm diameter in the concrete surface.

#### **2.11 Preparation**

The contractor shall:

- Ensure that forms and adjacent surfaces are thoroughly cleaned to receive concrete and all debris, including sawdust is removed just before placing concrete.
- Locate concrete construction joints so that they do not impair strength or appearance of the structure.

#### **2.12 Finishing Formed Surfaces**

The Contractor shall:



- Repair and patch defective areas with fins and other projections completely removed or smoothed.
  - To smooth concrete where fins and other projections have formed moisten concrete surface within a day after forms have been removed and rub with carborundum brick until surface is a uniform colour and texture within the projection limits.
  - Not apply cement ground other than that produced by the rubbing process.
  - Remove and replace concrete having defective surfaces if defects cannot be repaired to the satisfaction of the superintendent.
- Surface defects shall include colour and texture irregularities, cracks, spills, air bubbles, honeycombs, rock pockets, fins and other projection on the surface, stain and form tie holes.

The contractor shall:

- Undercut voids larger than 25mm diameter and fill with fresh concrete after thoroughly wetting concrete surfaces.
- Fill small holes and irregularities using 2:1 (Portland cement to fine sand by volume) grout mixed with approved bonding admixture according to manufacturer’s specification.
- Blend standard Portland cement with white Portland cement if necessary so that final colour of dry grout will match adjacent surfaces.
- After applying grout to repair area, wipe with Hessian cloth to match adjacent texture and within the specified surface tolerances.
- Keep concrete patch damp with fog spray for at least 36 hours.
- The measurement will be as per IS 1200

**3.00 CONCRETE REINFORCEMENT**

**3.01 Related Works**

- A. Concrete Formwork
- B. Cast in situ Concrete

**3.02 Steel Grades**

Reinforcements for concrete may be from any of the “grades” of steel indicated below, conforming to the relevant Indian Standards mentioned against each:

Grade	Description	Conforming to
Fe 250	Mild Steel	IS 432 (Part I)
Fe 415	High strength deformed/ ribbed steel	IS 1786
Fe 500	High strength deformed / ribbed steel	IS 1786
Fe 550	High strength deformed / ribbed steel	IS 1786

Reinforcing steel may be any of the following types:

- Type I Plain round bars (PR)
- Type II Welded wire Fabrics (WWF)
- Type III Cold Twisted Deformed Bars, Corrosion resistant bars. (CTD-CR)
- Type IV Thermo-Mechanically Treated Ribbed bars (TMT)

**3.03 Quality Assurance**

- a. Supervisory staff shall have qualification and experience in the above field.
- b. Welders qualified and having approved certificates for welding shall be employed.

**3.04 Submissions**

- a. Contractor shall submit shop drawings for all concreting items including bar diameter, location, spacing cover, length, bent shape and tonnage.
- b. Certificates showing the specification and test results of the source of reinforcement shall be provided.

**3.05. Storage and Handling**

- a. Store reinforcement clear off the ground to prevent damage and accumulation of dirt, rust and other deleterious matter.
- b. Bend test requirements shall conform to the following and shall be based on 180° bends of full size bars around pins.

<b>Bar diameter (mm)</b>	<b>Pin diameter for test bend</b>
10, 12,16	3.5 x bar dia
20, 22, 25	5.0 x bar dia
28, 30, 32	7.0 x bar dia

- c. Spacers shall be of any of the following:

- i. Wire
- ii. Precast concrete
- iii. Moulded plastic

Spacer material shall be of durable quality and shall not lead to corrosion of reinforcement or spilling of concrete.

Precast concrete spacers shall be of the same mix as that of surrounding concrete.

- d. Tying wire shall be of 18 G black annealed mild steel wire or other approved type double fold to tie the reinforcements.

**3.06 Execution**

**3.06.1 Cutting and Bending**

- a. Flame cut and hot bending is absolutely forbidden.
- b. Cut and bend reinforcement to approved shop drawings and details.
- c. Cold - bend bars on approved machines.
  
- d. Do not rebend without approval. In case of re bending, care shall be taken that the rating of bend is not less than 4 x bar dia at construction joints for plain steel bars and 6 x bar dia for high strength bars.
- e. Reinforcement projecting from concrete shall not be bent without approval.  
Bar bending schedule to be submitted to the Project Manager prior to commencement of any cutting, bending and binding of steel at site.

**3.06.2 Welding**

- a. Do not weld reinforcement unless authorized by the Project Manager and recommended by the manufacturers.
- b. Site welding shall be done with suitable safeguards and techniques.
- c. Welding, if approved, may be used for:
  - i. Lapping reinforcement in position
  - ii. Fixing reinforcement to other steel members.
- d. The length of run deposited in a single pass shall not exceed 5 x bar diameters. If a longer welded length is required divide into sections with the space between runs not less than 5 x bar diameters.
- e. Welded joints:

- i. Shall not be made at bends in reinforcement.
- ii. Stagger joints in parallel bars of principal reinforcement unless otherwise approved.
- iii. The distance between staggered joints shall not be less than the end anchorage length joints.

**3.06.3 Mechanical Splicing**

- a. To comply with ISI 456-2000. ACI 318-1983 and ACI 439-3R-83
- b. Use as indicated in structural drawings.
- c. Consultant has to approve mechanical splices before using it at site.

**3.06.4 Inspection**

- a. Ensure that the reinforcement placing is checked by Project Manager.
- b. Ensure that the Formwork to receive the reinforcement is clean and free from debris.

**3.06.5 Anchorage and Laps**

- a. Bars shall have minimum anchorage and lap lengths in accordance with IS: 456 - 2000.
- b. Areas having congested sections shall be provided with tension / compression mechanical splices as per ACI 318-83 and advice of Structural Consultants.

**3.06.6 Securing Reinforcement**

- a. Adequately secure with tying wire or approved steel clips.
- b. Bend the tying wires well back clear of forms.

**3.06.7 Concrete Cover**

- a. Shall be in accordance with ISI: 456-2000 and as per the instructions in structural drawings.
  - i. Footings, retaining walls and
    - Similar members in contact with earth but not cast against earth - 50 mm
  - ii. Slabs - 20 mm
  - iii. Walls, ribs - 20 mm
  - iv. Beams:
    - For main bars - Min.25 mm or dia. of the bar
    - For stirrups - 15 mm
  - v. Columns - 40 mm
    - Columns less than 20 cms - 25 mm
  - vi. Water tanks:
    - In contact with water - 40 mm
    - In contact with air - 20 mm
  - Vii walls in contact with water / Earth - 40mm

**3.06.8 Spacers Chairs and Other Supports**

- a. Provide necessary supports to maintain reinforcement in its correct position.
- b. Provide spacer bars of same diameter as longitudinal bars but not less than 25mm diameter between two layers at 1.5 mm centers except where bundled bars are detailed.

**3.06.9 Precautionary Measures**

- a. Do not insert bars into placed concrete.
- b. Do not damage forms and form linings, if any when fixing reinforcement.

### **3.06.10 Adjustment and Cleaning**

- a. Check reinforcement prior to and during placing concrete with particular attention to the top reinforcement in Cantilever sections.
- b. Ensure that reinforcement is clean and free from corrosive pitting, loose rust, loose mill scale, oil and other substances, which may adversely affect reinforcement concrete or the bond between the two.
- c. Protect the projecting reinforcement from weather where the rust staining of exposed concrete surfaces may occur.

### **3.07 Measurements**

Measurements will be as per IS 1200 for reinforcement steel. Laps in slabs, beam, chairs are not measurable in quantities. Column reinforcement above each slab as lap is measurable. The unit rates to cover above norms and rolling margins as measurement will be based on theoretical weights only. Mechanical splices if required for use by Project Manager are measured separately.

## **4.00 CAST IN-SITU CONCRETE**

### **4.01 Related Work**

- a. Concrete Formwork
- b. Concrete Reinforcement
- c. Concrete Finishing
- d. Sealants

### **4.02 Definitions**

- a. Water / Cement Ratio:  
The ratio by weight of water to cement in a mix expressed as a decimal fraction. Water being that which is free to combine with cement, including free water in aggregate but excluding that.
- b. Hot Weather:  
Shade air temperature of 37° C and higher.

### **4.03 Quality Assurance**

- a. Supervising staff shall have qualifications and experience specified in the contract.
- b. The following tests shall be carried out by the approved agency:
  - i. Testing preliminary test cubes;
  - ii. Testing work test cubes;
  - iii. Testing in situ concrete at site by hammer test, ultrasonic tests and core tests.
- c. Standards:  
Comply with the following codes, specifications and standards and as shown on the drawings.
  - i. IS 456: 2000 - Specifications for plain and reinforced concrete.
  - ii. IS 269:1976 or latest amendment - Specifications for ordinary and low heat Portland cement.

**4.04 Submittals**

SAMPLES:

**5.00 MATERIALS****5.01 Cement**

a) Cement shall be of Portland type and shall comply of IS: 269. The cement used shall be of approved manufacture and the sources of supply shall not be changed without approval of the Project Manager.

**5.02 Aggregate**

- a. To be crushed naturally occurring materials conforming to IS: 383.
- b. Aggregate, 95% of which shall be retained on 4.75 mm test sieve.
- c. Aggregate shall be from crush granite, quartzite, trap, and basalt quarries.
- d. Free from soft friable thin porous laminated or flaky pieces.
- e. Free from dust and foreign matters
- f. Shall be chemically inert when mixed with cement.
- g. Shall be angular in shape
- h. Maximum size of the aggregate shall be 20mm.
- i. Shall have a minimum Specific gravity of 2.6(Standard surface dry basis)

**5.03 Fine Aggregate**

- a. Shall be washed dry sand and shall confirm to IS: 383.
- b. Shall pass through IS sieve 4.75mm test sieve leaving a residue not more than 5%
- c. Shall not contain any traces of silt.

**5.04 Water**

- a. Water for mixing shall be from potable supply system or from bore well supply.
- b. Water for curing shall be from potable supply or from bore well supply.
- c. Water which may erode or discolour concrete or which has got more than 1000 ppm of chloride content shall not be used.

**5.05 Expansion and Contraction Joints**

- a. Joint filler shall be Bitumen impregnated shalitek board 25mm for expansion joint.
- b. Poly sulphate based joint sealants shall be provided in expansion joint.
- c. Sliding type neoprene bearing pad of structural grade for expansion joints.

**5.06 Miscellaneous**

- a. Chemical curing compound of approved make to form a membrane or surface which will disintegrate and flake from that surface over a period of days commencing at least 7 days after application.
- b. Vapour barrier and separation layer to underside of concrete slab, and grade 10 mil (.25 mm) thick polyethylene sheets with laps 100mm on sides and ends.

**5.07 Delivery & Storage**

- a. Cement shall be delivered in original sealed and banded bags and shall be stored and neatly stacked above the ground by at least 8", staking each batch separately and using in order of delivery.
- b. Cement deteriorated or clotted shall not be used.
- c. Cement register showing receipts and consumption shall be maintained.
- d. Sand shall be stacked carefully on a clear, hard, dry surface and shall not get mixed with deteriorated foreign materials.
- e. Suitable concrete/any platform provided if a proper surface is not available.
- f. Suitable concrete factor shall be adopted for any blockage.

**6.00 PROPORTIONING, BATCHING & MIXING OF CONCRETE****6.01 Proportioning****a. Aggregate**

The proportions, which shall be decided by conducting preliminary tests shall be by weight. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete batching by means of weight batchers conforming to I.S. 2722 capable of controlling the weights within one percent of the desired value. Except where it can be shown to the satisfaction of the Project Manager that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending training the coarse aggregate in different sizes and blending them in the right proportions. The different sizes shall be stocked in separate stockpiles. The grading of coarse and fine aggregate shall be checked as frequently as possible, as determined by Project Manager to ensure maintaining of grading in accordance with the samples used in preliminary mix designs. The material shall be stockpiles well in advance of use.

**b. Cement**

The cement shall be considered by weight, for design mix.

**c. Water**

Only such quantity of water shall be added to the cement and aggregates in the concrete mix as to ensure dense concrete, specified surface finish, satisfactory workability, consistent with the strength stipulated for each class of concrete. The water added to the mix shall be such as not to cause segregation of materials or the collection of excessive free water on the surface of the concrete.

**d. Definition of Water/Cement Ratio**

The water cement (W/C) ratio is defined as the weight of water in the mix (including the surface moisture of the aggregates) divided by the weight of cement in the mix.

**e. Water/Cement Ratio**

The actual water cement ratio to be adopted shall be determined in each instance by Contractor and approved by the Consultants / Project Manager.

**f. Proportioning by Water/Cement Ratio**

The W/C ratio specified for use by Consultants / Project Manager shall be maintained. Contractor shall determine the water content of the aggregates as frequently as desired by the Consultants / Project Manager as the work progresses and as specified in IS 2386 (Part III) and the amount of mixing water added at the mixer shall

be adjusted as directed by the Consultants / Project Manager so as to maintain the specified W/C ratio. To allow for the variation in their moisture content, suitable adjustments in the weights of aggregates shall also be made.

## **6.02 Batching and mixing of concrete**

a. The proportions of the materials for the concrete mix as established by the preliminary test for mix design shall be followed for all the concrete in the works and shall not be changed except when specifically permitted by the Project Manager.

b. If approved by the Project Manager concrete may be produced by volume batching the ingredients except the cement. Fine and coarse aggregate shall be proportioned volumetrically by subsequent conversion of the weights of volumes knowing their bulk densities as stipulated in Para 9.2.2 or I.S. 456-2000. All concrete shall be mixed in mechanically operated batch mixers complying with I.S. 1791 of approved make with suitable provisions of correctly controlling water delivered to the drum. The quality of water actually entering the drum shall be checked with reading of gauge or valve setting before starting the job. The test shall be made while mixer is running. The volume of the mix material shall not exceed the manufacturer's rated mixer capacity. The batch shall be charged into the mixer so that some water will enter the drum in advance of cement and aggregates. All water shall be in the drum by the end of 15 seconds of the specified mixing time. Each batch shall be mixed until the concrete is uniform in colour for the minimum period of 2 minutes after all the materials and water is in the drum. The entire contents of the drum shall be adjusted in one operation before the raw materials for succeeding batches are fed into the drum. The entire contents of the drum shall be adjusted in one operation before the raw materials for succeeding batches are fed into the drum. The weighing gauge of mix shall be periodically checked or as directed by the Project Manager. The contractor shall carry out rectifications immediately if found necessary.

Mixer and the weight batcher shall be maintained in clean and serviceable condition. The accuracy of the weight batcher shall be periodically checked. Both mixer and the weight batcher shall be set up level on firm base and the hopper shall be loaded evenly. The needle shall be adjusted to zero when the hopper is empty. Fine and coarse aggregates shall be weighed separately.

Each time the work stops, the mixer shall be cleaned out and the next commencing the mixing, the first batch shall have 10% additional cement to allow for striking in the drum.

## **6.03 BATCHING AGGREGATE BY VOLUME**

a. Obtain approval before using this method.

b. Batch cement by weight and water by either weight or volume.

c. Measure aggregate in metal container whose depth is not less than their greater width and the size of which is such as to enable the whole to be easily checked.

d. Concrete shall be mixed in concrete mixers until a uniform distribution of the material, and a uniform colour and consistency is obtained.

e. Concrete mixing shall in no case be less than two minutes.

f. Each batch shall be so charged into the mixer that approximately 10% of the water enters the drum before the cement and aggregate. Water shall be added gradually while the drum is in motion, so that all the water is in the drum until the first quarter of the minimum time.

- g. The amount of concrete mixed in drum shall not exceed the rated capacity of the mixer and the whole of the material shall be removed before a fresh batch enters the drum.
- h. Do not modify the mixed concrete either by addition of water or cement or other means.

#### **6.04 CLEANLINESS**

- a. Clean mixer and handling plant by washing with clean water at the end of the work and at intervals of 30 minutes during mixing.
- b. If old concrete mix remains in the mixer drum, rotate the drum with clean aggregate and water before mixing the cement.

#### **6.05 PLANNING OF CONCRETE**

- a. Consultant shall be informed 24 hrs. in advance before the pour of each concrete to allow for inspection of reinforcement, sizes and levels of the members to be concreted, concrete cover, cleanliness, filling of gaps and wide and supporting props.
- b. Ensure that the spaces to receive concrete are clear free from debris and free from water.
- c. Transportation: Use approved method to identify that the grade of concrete to be placed in proposed location.
- d. Use suitable stools, walkways, barrow runs, for traffic over reinforcement or freshly placed concrete.
- e. Clean the transportation equipment immediately after use or whenever cement and aggregate is used by using clean water.

#### **6.06 PLACING OF CONCRETE**

- a. Record time and date of all concrete pours.
- b. Pour concrete whilst it is sufficiently plastic for full composition.
- c. Avoid double handling
- d. Do not discharge concrete through reinforcement or other obstruction in a way, which may cause uneven disposal, segregation or loss of ingredients.
- e. Do not move concrete into position with rakes or vibrators.
- f. Use suitable chutes or trunking to place concrete where reinforcement is congested.
- g. Place concrete in final position in one continuous operation up to movement and construction joints.

#### **6.07 COMPACTION**

- a. Compact to full depth of fresh concrete to ensure full compaction and amalgamation with previous batches. Do not damage adjacent partly hardened concrete.
- b. Compact until air bubbles cease to appear.
- c. Concrete shall be thoroughly worked around the reinforcement embedded fixtures, spaded against corners of the form work by punning, roding or by any other approved means and the member compacted by mechanical vibrator approved by the Project Manager.
- d. Vibrators shall be of immersion type with frequency of 100 Hz. minimum when operating in concrete, or the exterior with a frequency of 50 Hz. minimum. The number and size shall be as such to ensure vibration through out the volume of the concrete.
- e. Apply vibrators systematically at such intervals that zones of influence overlap.



f. Apply vibrators at any one point only until proper compaction is achieved and no segregation occurs.

**6.08 CASTING GROUND SLABS**

a. Cast in strips and not in alternate bays.

b. Casting walls:

Cast in successive pours working away in both directions from the center with no shrinkage gaps except for a final closure.

c. Casting kickers:

Casting kickers shall be the same grade as for the main member and shall be vibrated or rammed into place and prepared as for other joints.

d. Casting kickers for walls monolithic with foundation concrete.

e. Casting kickers for columns after foundation/slabs or cast.

**7.00 MIXES**

1. Select the mixed proportion for each type of concrete to produce the required performance based on the results of tests and trial mixer.

2. Concrete shall be of specified quality and be capable -

a. Of being placed without excessive segregation and,

b. When hardened, capable of developing all specified characteristics.

c. Control Concrete

- To have pre determined grading of all aggregates

- Pre determined proportion of coarse aggregate, fine aggregate, cement and water for the required strength.

d. Strength shall mean acceptable field strength after 28 days of curing on the tests conducted on cubes from concrete taken during concreting.

e. The tests and the concrete taken during concreting shall confirm to IS: 456.

f. Statement of acceptable field strength has:

Compression strength on 15 cm. cubes

Grade of concrete

at 28 days

(1)	Preliminary test		Work test minimum kg/sq.cm.
	minimum kg/sq.cm.	(3)	
M 10	135		100
M 15	200		150
M 20	260		200
M 25	320		250
M 30	380		300
M 35	440		350
M 40	500		400

g. Control concrete shall be proportioned to obtain the required strength by conducting lab tests using the coarse aggregate, sand and cement based on the design mix.

h. Control concrete shall have suitable workability for proper consolidation.

i. At places having heavy reinforcement when compacting concrete is a problem, the control concrete shall be designed with special care to the required strength and workability at no extra cost.

- j. Testing facilities to access the moisture content of aggregate at frequent intervals, testing of concrete cubes and testing of aggregate shall be done at the site by establishing testing laboratories.
- k. Concrete shall be weighed batched. The dials of weigh-batching units shall be checked with standard weights periodically.
- l. Under special circumstances the conversion of weights to volumes will be allowed by the Project Manager.
- m. The minimum quantity of cement to be used for 43 grade of concrete is as follows:

**NOTE:** These are minimum quantity of cement to be used irrespective of the design mix.

#### **7.01 Standard Deviation:**

##### **7.01.1 Assumed Standard Deviation**

Where sufficient test results for a particular grade of concrete are not available, the value of standard deviation given in Table below may be assumed.

Grade of Concrete	Assumed Standard Deviation N/Sq.mm
M 10	2.3
M 15	3.5
M 20	4.6
M 25	5.3
M 30	6.0
M 35	6.3
M 40	6.6

However, when adequate post records for a similar grade exists and justify to the designer a value of standard deviation different from the shown in table above, it shall be permissible to use that value.

##### **7.01.2 Standard deviation based on Test Results**

- i. Number of test results - Total number of test results required to constitute an acceptable record for calculation of standard deviation shall be not less than 30. Attempts should be made to obtain the 30 test results, as early as possible, when a mix is used for the first time.
- ii. Standard deviation to be brought up to date - The calculation of the standard deviation shall be brought up to date after every change of mix design and at least once a month.

##### **7.01.3 Determination of Standard Deviation**

- i. Concrete of each grade shall be analysed separately to determine its standard deviation.
- ii. The standard deviation of concrete to a given grade shall be calculated using the following formula from the results of individual tests of concrete of that grade obtained as specified for test strength of sample.

- iii. Estimated standard deviation  $S = \text{Square root of (sum of squared deviations of the individual strength of } n \text{ samples divided by } n-1)$  where  $n = \text{number of sample test results}$ .
- iv. When significant changes are made in the production of concrete batches (for example changes in the materials used, mix design, equipment of technical control), the standard deviation value shall be separately calculated for such batches of concrete.

#### **7.01.4 DEPTH OF LIFT**

- a. Determine the depth of lift to be concreted in consultation with the Project Manager. A cohesive mix, which does not segregate may fall freely through any distance, provided neither formwork nor reinforcement are damaged or displaced.

#### **7.01.5 JOINTS**

##### **Construction Joints**

- a. Keep the no. of construction joints to a minimum consistent with reasonable precautions against shrinkage.
- b. Locate to take due account of shear and bending stresses.
- c. Arrange joint line to coincide with feature of finished work.
- d. Form at right angles to main reinforcement.
- e. Reinforcement shall continue through joints.
- f. Provide with a key in walls slabs as shown in drawings.

##### **Horizontal joints in walls**

- a. Form horizontal joints in walls designed to be continuous with floor slabs at the top of an integrally cast kickers minimum 25mm high. No other horizontal joints will be allowed.

##### **Form horizontal joints in walls other than in (a) above:**

- a) At the top of footings
- b) At the top of slabs
- c) At a minimum 20mm above the soffit of beam or girders connecting into columns.
- d) 15mm above soffit of suspended floors.

##### **Construction joints in ground slabs:**

- a. To comply with IS codes
- b. To align with column or grid lines where practicable.

##### **Isolation joints:**

- a. Form diamond shaped or circular separations around columns.
- b. Ensure all edges of slabs are isolated from adjoining construction.

##### **Control joints:**

- a. Space at 4 - 7 meter in width for one panel.
- b. Form by either:
  - i. Sawing a continuous straight line in the top of the slab
  - ii. Grooving fresh concrete with hand grooves

- iii. Placing strips of wood, metal or pre-moulded joint material at joint locations. Top edges of strips shall be flush with concrete.
- iv. Control joints shall be extended  $1/5$  to  $1/4$  times slab thickness into the slab.

**Construction joints in suspended slabs:**

- a. Locate near the middle of slabs, beams, or girders, unless a beam intersects a girder at the middle location, in which case offset joints in girders a distance equal to twice the width of the beam.
- b. Make provision for transfer of shear and other forces through construction joints.

**Vertical joints in walls:**

- a. Space not exceeding 5m centers and also locate where abrupt changes in thickness or height occur, at least 2m from corner.

**Curing and Protection**

- a. Protect freshly placed concrete from premature drying and excessive cold or heat.
- b. Maintain concrete without drying, at a relatively constant temperature, for the time necessary for hydration of the cement and proper hardening.
- c. Initial curing to commence as soon as free moisture disappears from concrete surface after placing and finishing.
- d. Keep concrete continuously moist for at least 72 hours.
- e. Final curing commence immediately following initial setting and before concrete has dried.
- f. Final curing to continue for at least 7 days in accordance with IS standard.

**7.01.6 CURING METHODS**

- a. Cure concrete by moisture curing.
- b. Obtain approval for curing methods:
  - 1. Where structural members are of considerable depth or of bulk.
  - 2. Have an unusually high proportion of cement.
  - 3. If concrete incorporate admixtures.
  - 4. If special or accelerated curing methods are proposed.

**Moist Curing:**

Execute by either:

- a. Covering the surface with water and keeping continuously wet.
- b. Continuously spraying with water.

**Liquid Membrane Curing:**

- a. Apply a membrane forming curing compounding in accordance with the manufacturers recommendations immediately after any water sheen which may develop after finishing has disaffected from the surface and within two hours of striking Formwork on formed surfaces.

**7.01.7 SITE QUALITY CONTROL**

**Slump tests**

- a. Test fresh concrete in accordance with IS standard periodically during the day and when directed.
- b. Increase the requirements of slump test when washed sand is used.
- c. Keep on site' moisture content' to enable doses of water and sand in a mix to be provided at site.
- d. The following slumps shall be adopted for different kinds of work.

Sl. No.	Description	With Vibrator	
1.	Mass concrete in RCC foundation footings and reinforcing walls.	10-25mm	
2.	Beams, Slabs & column	25-40mm	
3.	Thin RCC section with heavy steel	40-50mm	25-150mm

**Strength tests**

- a. Preliminary test cubes made with concrete taken from test mixes, in accordance with IS standard.
- b. Work test cubes made in accordance with IS standard.

**Test cubes**

- a. Size: 150 mm x 150 mm x 150-mm. cubes.
- b. To be legibly marked with the location, date of concreting.
- c. Where the concrete in the works is to be vibrated or not vibrated, the cubes must be casted according to the IS standards.
- d. Where the concrete in the works is uncompacted, pour the concrete into the mould in three layers and compact each layer with a 16mm dia-tamping rod.

**Trial mix**

- a. Within 7 days of signing the contract and before commencing work on site, prepare trial mixes for each type of concrete and submit 6 preliminary test cubes from each mix to the testing authority.
- b. The testing authority shall test three test cubes at 7 days and three at 28 days for each type of mix where the difference between the higher and the lowest test results from any one trial mix at 7 days exceeds 15% of the average and any cube weaker than the minimum

requirement, make a further trial mix, increasing the proportion of cement if necessary to obtain the required strength.

- c. If any test results from any one-trial mix fail to exceed the minimum strength at 28 days:
  - i. Remove from site materials from which the trial mix was prepared.
  - ii. Provide new materials and prepare and test further trial mixes until specified requirements are achieved.

### Work test cube

- a. Take test cube as specified from fresh mixed concrete which is being used in the works and which has been prepared in the normal way.
- b. Take at least 6 cube for each sampling and test 3 at 7 days and 3 at 28 days.
- c. Strength of cubes shall not be less than the minimum strength requirements for each type of concrete.
- d. If works test cubes fail at 7 days, at your option, defective concrete maybe removed and replaced without awaiting the 28-day test results.
- e. If works test cubes fail at 28 days:
  - Suspend concreting operations and do not proceed further without approval.
  - Take test cores in accordance with IS standard or conduct in situ load tests in accordance with IS standard on suspect work, in the presence of the Project Manager.
  - Replace all defective work.
  - Re-testing shall be executed to the Consultants / Project Manager 's approval.
- f. Bear all costs resultant upon the steps taken in (5) above.
- g. Frequency of sampling:
- h. Structural Concrete:

At least once for each individual part of the structure, or at least once per 100 cubic meters of concrete; whichever occurs more frequently.

### Schedule of tolerances

- a. The concrete work shall be constructed to an accuracy, which shall permit the proper assembly of components and installations and shall compatible with the finish. The accuracy of the work shall be within the tolerances stated on the Drawings or specified elsewhere and, in the absence of any other requirements, shall comply with the following:

All laying out dimensions	± 5mm
Sections of concrete members	± 5mm
Surface of foundations against ground	- 5 + 10mm
Top surface of foundations, bases and piers.	+ 5 - 20mm
Surface level of floor slabs to datum	± 10mm
Plumb of columns and walls	± 5mm
Plumb of columns and walls in storey height	± 5mm
Plumb of columns and walls in full building height	± 20mm
Inside faces of lift shafts in storey height	± 5mm
Inside faces of lift shafts in full building height	± 10mm

## 7.02 ORDINARY CONCRETE

- a. Ordinary cement concrete where specified shall be used
- b. Proportions 1:3:6, 1:2:4, 1:1.5:3, etc., in the specification refers to the quantity of cement by volume, dry coarse sand by volume, quantity of coarse aggregate by volume.
- c. Cement shall be weighed based on 1 cum. of cement weighs 1440 kgs or 1 full bag of cement 50 kgs corresponding to 35 lts. by volume.
- d. Correction factors to be applied for bulking of sand when the sand is either wet or moist.
- e. Water cement ratio used shall be just sufficient for the workability of concrete.

f. Minimum strength of concrete shall be obtained as below:

Sl.#	Proportion of concrete	Preliminary tests	Work tests
1.	1:3:6	135 kg/sq.cm.	100 kg/sq.cm.
2.	1:2:4	200 kg/sq.cm.	150 kg/sq.cm.
3.	1:1.5:3	265 kg/sq.cm.	200 kg/sq.cm.

Comprehensive strength of concrete shall be obtained by testing 15 cm. cubes at 28 days curing.

- g. Testing: 6 cubes shall be taken from any mix, 3 of them to be tested at 7 days, 3 at 28 days.
- h. Strength of concrete at 7 days shall be 2/3rds of the strength of concrete at 28 days.
- i. Strength of concrete at 28 days shall be as mentioned in table above and the criteria for accepting concrete is only the strength of concrete at 28 days.

**7.03 Admixtures:**

**7.03.1 General**

Admixtures may be used in concrete only with the approval of Consultant / Project Manager based upon evidence that, with the passage of time, neither the compressive strength nor its durability get reduced. Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement, or embodied steel parts. When calcium chloride is permitted to be used, such as in mass concrete works, it shall be dissolved in water and added to percent of the weight of the cement in each batch of concrete. When admixtures are used, the designed concrete mix shall be corrected accordingly. Admixture shall be used as per manufacturer's instructions and in the manner and with the control specified by Consultant / Project Manager.

**7.03.2 Air entraining Agent**

Where specified and approved by Consultant / Project Manager, neutralized vinsol resin or any other approved air entering agent may be used to produce the specified amount of air in the concrete mix and these agents shall conform to the requirements of ASTM Standard 6 - 260, Air Entering admixtures for concrete. The recommended total air content of the concrete is 4% plus or minus 1%. The method of measuring air content shall be as per IS 1199.

**7.03.3 Retarding admixtures**

Where specified and approved by Project Manager retarding agents shall be added to the concrete mix in quantities specified by Project Manager.

**7.03.4 Water reducing admixtures**

Where specified and approved by Project Manager water reducing lignosulfonate mixture shall be added in quantities specified by Project Manager. The admixtures shall be added in the form of a solution.

**7.03.5 Water Proofing Agent:**

Where specified and approved by Project Manager, chloride and sulphide free waterproofing agent shall be added in quantities specified by Project Manager.

### 7.03.6 Other Admixtures:

- a. The Project Manager may at his discretion instruct the contractor to use any other admixtures in the concrete.
- b. If the Contractor so wishes to use admixtures, then the following should be adhered to (subject or Project Manager's approval).
- c. No reduction will be allowed to target mean strength when compared to admixture free concrete of the same class.
- d. Dosage of admixture shall be strictly in accordance with the manufacturers instruction.
- e. The following information about the admixture shall be submitted to the Project Manager for record and approval.
  - Long and short term effects of the admixture in the concrete.
  - Effect of admixture of concrete permeability.
  - Effects of over and under dosage.
  - Shortage life and special storage requirements.
- f. The Contractor when requested shall provide the services of a full time field technician of the admixture manufacturer to advise the proper addition of the admixture to the concrete or adjustment of concrete mix proportions to meet changing conditions.
- g. The Contractor shall furnish a statement of responsibility from the admixture manufacturer for their products.
- h. If the use of admixture is approved by the Project Manager, it shall be constructed as a constructing part of the concrete without any extra payment.

## 8.00 READY MIX CONCRETE

Reference - IS 4926-1976

### 8.01 TERMINOLOGY

For the purpose of this standard, the definitions in 1.1 to 1.4 shall apply.

8.01.1 Ready Mixed Concrete - Concrete delivered at site or into the purchaser's vehicle in a plastic condition and requiring no further treatment before being placed in the position in which it is to set and harden.

8.01.2 Agitation - The process of continuing the mixing of concrete at a reduced speed during transportation to prevent segregation.

8.01.3 Agitator - Truck mounted equipment designed to agitate concrete during transportation to the site of delivery.

8.01.4 Truck mixer - A mixer generally mounted on a self-propelled chassis capable of mixing the ingredients of concrete and of agitating the mixed concrete during transportation.



## 8.02 TYPES

Concrete-mix - Concrete shall be produced by completely mixing cement, aggregates, admixtures, if any and water at a stationary central mixing plant and delivered in containers fitted with agitating devices.

## 8.03 MATERIALS

Cement - The cement used shall be ordinary Portland cement or low heat Portland cement conforming to IS-269-1976\* or Portland slag cement conforming to IS 455-1976+ or Portland-pozzolana cement conforming to IS: 1489-1976+ or rapid hardening Portland cement conforming to IS 8041E-1976## as may be specified by consultant at the time of placing the order. If the type is not specified ordinary Portland cement shall be used.

8.04 Fly ash when used for partial replacement of cement, shall conform to the requirements of IS: 3812 (part I)-1966.

8.05 Water used for concrete shall conform to the requirement of IS: 456-1964.

8.06 Admixtures shall only be used when so agreed to between the purchaser and the manufacturer. The admixtures shall conform to the requirements of IS 456-1964 and their nature, quantities and methods of use shall also be specified. Fly ash when used as an admixture for concrete shall conform to IS: 3812 (Part II)-1966.

8.07 Measurement and Storage of Materials - Measurement and storage of materials shall be done in accordance with the requirements of IS: 456-1964.

## 9.00 BASIS OF SUPPLY

9.01 The ready mixed concrete shall be manufactured and supplied on the following basis.

a) Specified strength based on 28-day compressive strength of 15-cm cubes tested in accordance with IS: 456-1964.

When the concrete is manufactured and supplied on the basis of specified strength, the responsibility for the design of mix shall be that of the manufacturer and the concrete shall conform to the requirements specified in 7.

9.02 Measurement of Ready-Mixed Concrete

The basis of purchase shall be the cubic metre of plastic concrete as delivered to the purchaser.

9.03 The volume of plastic concrete in a given batch shall be determined from the total mass of the batch divided by the actual mass per cum. of concrete. The total mass of the batch shall be

calculated either as the sum of the masses of all materials, including water, entering the batch or as the net mass of concrete in the batch as delivered. If the purchaser wishes to verify the total mass of the batch, this shall be obtained from the gross and tare masses of the vehicle on a stamped weigh bridge. The mass per cum. shall be determined in accordance with the method given in IS: 1199-1959.

## **10.00 GENERAL REQUIREMENT**

10.01 In addition to the requirements specified in this standard and subject to such modifications as may be agreed to between the purchaser and the manufacturer at the time of placing order, the ready-mixed concrete shall generally comply with the requirements of IS: 456-1964.

10.02 The minimum quantity of cement and the details regarding proportioning and works control shall be as per tender clause 7.00/2m.

10.03 When a truck mixer or agitator is used for mixing a transportation of concrete, no water from the truck-water system or from elsewhere shall be added after the initial introduction of the mixing water for the batch. No works can be added if so ..... .. changes changing design mix strength.

10.04 Unless otherwise agreed to between the purchaser and the supplier, when a truck mixer of agitator is used for transporting concrete, the concrete shall be delivered to the site of the work and discharge shall be complete within 1.5 hours (when the prevailing atmospheric temperature is above 20°C) and within 2 hours (when the prevailing atmospheric temperature is at or below 20°C) of adding the mixing water to the dry mix of cement and aggregate or of adding the cement to the aggregate, whichever is earlier.

10.05 Temperature - The temperature of the concrete at the place and time of delivery shall be not less than 5°C. Unless otherwise required by the purchaser, no concrete shall be delivered, when the site temperature is less than 2.5°C and the thermometer reading is falling.

10.06 The temperature of the concrete shall not exceed 5 C above the prevailing shade temperature, when the shade temperature is over 20 C. The temperature of concrete mass on delivery shall not exceed 40 C.

10.07 Sampling and testing: Adequate facilities shall be provided by the manufacturer for the purchaser to inspect the materials used, the process of manufacture and the methods of delivery of concrete. He shall also provide adequate facilities for the purchaser to take samples of the materials used.

10.08 Sampling and testing - Unless otherwise agreed to between the purchaser and the supplier, the sampling and testing of concrete shall be done in accordance with relevant requirements of IS: 456-1964, IS: 1199-1959 and IS: 516-1959.

10.09 Consistency or workability - The tests for consistency or workability shall be carried out in accordance with requirements of IS: 1199-1959 or by such other method as may be agreed to between the purchaser and the manufacturer.

10.10 Strength Test - The compressive strength and flexural strength tests shall be carried out in accordance with the requirements of IS: 516-1959 and the acceptance criteria for concrete whether supplied on the basis of specified strength or on the basis of mix proportion, shall conform to the requirements of Table 5 and other related requirements of IS: 456-1964.

10.11 Cost of Testing - Unless otherwise agreed to between the purchaser and the manufacturer, the cost of the tests carried out in accordance with the requirements of this specification shall be borne as follows:

- a) By the manufacturer if the results show that the concrete does not comply with the requirements of this standard.
- b) By the purchaser if the results show that the concrete complies with the requirements of this standard.

10.12 Manufacturer's Records and Certificates - The manufacturer shall keep batch records of the quantities by mass of all the solid materials, of the total amount of water used in mixing and of the results of all tests. If required by the purchaser, the manufacturer shall furnish certificates, at agreed intervals, giving this information.

**SECTION: MASONRY (-----)**

**1.00 SIZE STONE MASONRY / LATERITE MASONRY**

**General**

- a. Work included with size stone/ Laterite masonry, pointing, plastering & painting (if required.)

**1.01 Related Work**

- a. Includes scaffolding, ladders, platforms, staging and other accessories required for the execution of work.
- b. Masonry shall be at any height or depth as the case may be.
- c. Hacking and roughening of concrete or any other surface in contact with masonry for bondage.
- d. Rack out joints to specified depths either for plastering or pointing.
- e. Leveling and preparing the top course of masonry for damp proof course.
- f. Provide holdfasts and other inserts where required.

**1.02 Material**

- a. Size stone shall be of granite basalt or trap stone obtainable from approved quarry.
- b. Laterite masonry shall be from available laterite at site, which shall be dressed to the required sizes
- c. Size stone shall be of clean and neat sized and to have proper shape and dimension.
- d. Laterite blocks shall be of specified sizes including dressing
- d. Cement used shall be of Portland type
- e. Sand shall be clean river sand.
- f. The height of the course shall not be less than 15cm and all courses shall be of minimum height.

**1.03 Execution**

- a. Each course of the stone masonry shall not be less than 15cms.
- b. All courses shall be of uniform depth.
- c. The depth of higher course should not be more than depth of lower portion.

- d. Stones shall be hammer/chiseled dressed from the face to an extent of 75mm and 35mm towards the bed and side of the stones.
- e. Thickness of mortar joint shall not be more than 20mm.
- f. Stone shall break joints at least half the height of the course.
- g. Faces of stone shall be hammer dressed and bushing not more than 35mm.
- h. Edges of the face stones of exposed faces shall be chiseled in both longitudinal and vertical lines.
- i. All corners of exposed faces shall be two lines dressed 50mm wide.
- j. Bond stones shall be provided at intervals not exceeding two metres in each direction.
- k. Dressing of stones shall be done for super structure and not for masonry below the ground level.
- l. Bond stones shall be to the full width of the walls.
- m. Walls having width up to 60cms. thick shall have through bond stone and shall be in one piece.
- n. Walls over 60cms wide shall have bond stones either in one piece, if available locally or have the headers in series, each header overlapping the adjoining one by not less than 150mm.
- o. The filling of the masonry walls shall be with flat-bedded stones laid in mortar.
- p. Use chips, spalls, broken pieces of stones to fill the voids in stone masonry to avoid thick mortar joints.
- q. To avoid voids in stone masonry.
- r. No dry cement mortar shall be left in the masonry.
- s. Wet the stone before using.
- t. Mix the cement and sand by volume.
- u. Clean the masonry of extraneous matter, loose particles, and cement mortar adhering to the sides of the stones.

## **2.00 RANDOM RUBBLE MASONRY**

### **2.01 MATERIAL**

- a. Stone/ Laterite shall be carefully selected, edges shall be dressed with chisel.
- b. Stone/ Laterite shall be of equal size on face as far as possible.
- c. Stone/ Laterite shall be uniformly coloured and textured.

### **2.02 EXECUTION**

- a. Stone/ Laterite masonry shall be done by carefully fitting each stone to form neat and close joints.
- b. Stone/ Laterite shall be laid and solidly bedded in mortar and shall tail back and bonded well into backing.
- c. Stone/ Laterite shall not be greater than either the breadth of face or length of tail into the masonry work.
- d. Bond Stone/ Laterite one for every sq.m. shall be provided through the wall at spacings not more than a metre in one piece not greater than 600 mm thick.
- e. For wall width greater than 600mm header shall be laid from face to back and shall overlap each other atleast by 150mm.
- f. Stone/ Laterite shall be placed such that the joints break as much as possible and long vertical line joints shall be avoided.
- g. The quoins shall be of selected Stone/ Laterite neatly dressed with hammer chiselled to form required angle.
- h. The quoin shall be laid with header and stretcher alternatively.
- i. The cement mortar shall be of specified proportion and is on volumetric basis.
- j. Cement shall be weighed on the assumption that one cu.m. of cement weighs 1440 kgs.

### **3.00 WALL MASONRY**

#### **3.01 CONCRETE MASONRY UNITS**

- a. Hold load bearing units, non-load bearing units, solid bearing units.
- b. Masonry units shall be moulded in approved mounts and fabricated or pressed.
- c. Masonry units shall be of standard dimensions and to the correct width, length and height.
- d. Masonry units shall be cured before using in construction.

It is preferred to use factory manufactured concrete masonry blocks. However if the contractor wishes to manufacture at site, he may use the available site so that other activities are not hindered.

#### **3.02 REINFORCEMENTS, ANCHORAGES AND ACCESSORIES:**

- a. Provide wall ties rigid stripped anchor 30 mm wide, 3 mm deep and 450mm long turned off 50mm at one end for connecting wall courses with concrete.
- b. Use reinforcement 6mm dia. 2 nos. for every third course of hollow concrete block masonry for partitions 100 mm thick. Tie the reinforcements with 6mm. dia. bars at every 300mm centre to centre and the same concreted to a depth of 75mm with 1:2:4 concrete.
- c. Controlled joints, joint fillers, precast coping shall be provided where shown.

#### **3.03 Execution**

- a. Masonry works shall be executed as shown in drawings.
  - b. Provide setbacks, projections, cuttings, toothings, openings where required.
  - c. Clean and prepare surfaces as necessary.
  - d. Remove all dust and dirt and anything likely to reduce bond.
  - e. Prepare all items to be built in as the work proceeds, either supplied or installed by the civil contractors at appropriate locations. Over hand items provided by other sections of work are properly sized or located.
  - f. Establish lines, levels and courses.
  - g. Provide temporary bracing during erection of masonry works.
  - h. Place masonry to lines and levels indicated.
  - i. Maintain masonry courses to uniform width, make vertical and horizontal joints equally and of uniform thickness.
  - j. Lay concrete masonry units in staggered joint course one block unit and one mortar joint equaling to 200 mm high.
  - k. Masonry units shall be laid in full bed mortar properly jointed with other works.
  - l. Do not shift tapped masonry units after mortar has taken initial set.
  - m. Remove mortar wherever it is excess.
  - n. Overhand laying must not be done without approval.
  - o. Reinforcement shall be placed where required and in locations shown on drawings.
- Grouting of hollow areas shall be done after cleaning out holes and in maximum of 1.2m lifts with 15 to 60 minutes pause before the next lift absorbs the water.
- p. Consolidate the grout at the time of pouring with a flexible rod before the ground loses its elasticity.
  - q. Provide inserts and other accessories where shown on drawings.
  - r. Remove excess mortar and smears.
  - s. Remove defective mortar and match adjacent works.

- t. Clean Surfaces with non-acidic solution and which will not harm masonry or adjacent materials.
- u. Protect the exposed corners.
- v. Properly wet the surface while the masonry work is in progress till the mortar is properly set.

**3.04** Measurement : The areas are measured as built after deduction of areas of opening for windows, doors of ventilators.. The reinforcement used as per 3.02 are measured separate unit rates for concrete masonry to include cost of anchors.

## **SECTION: FLOORING (A - FLO)**

### **1.00 VACCUM DEWATERED CONCRETING & FLOORING**

#### **1.01 PREPARATION:**

1. The surface to receive flooring shall be clean, free from dirt and free from foreign material.
2. Any undulations or mortar remaining on the floor shall be trimmed.
3. Base course shall be trimmed.
4. The base shall be cleaned and watered before laying the floor.
5. Work includes at all depths and heights.
6. The finished surface shall be kept wet for a maximum period of one week.

#### **1.02 CONCRETING**

##### **GENERAL:**

1. Concreting shall have a concrete base of specified grade and M20 of specified thickness.
2. Flooring shall be laid in strips, the size of which is mentioned on the drawings.

##### **103 MATERIALS:**

Cement - Portland

Sand - River sand

Aggregate - Max. size 10 to 20mm

Water - Potable

Nito hardener (Optional) - @3kG/Sqm

Poly Sulphide sealant - At all control joints of size 10mmx6mm at every 200 Sqm area

#### **1.04 EXECUTION:**

- a) Mix cement, sand and aggregates in proportion 1:1.5:3 thoroughly with water to get an appropriate consistency.

- b) Prepared concrete shall be laid immediately after mixing.
- c) The base shall be free from water and other foreign materials, dust and dirt.
- d) The coat of cement Slurry of the consistency of thick cream shall be brushed on the surface of the base course.
- e) The Concrete shall then be spread over this base evenly and leveled carefully in panels as per specification given in concrete works.
- f) Low areas shall be filled with concrete and humps removed. Devacumisation shall be done for removing the voids.
- g) The whole concrete surface shall be leveled, compacted by ramming and trowelling.
- h) Prepared surface shall be allowed to set.
- i) Hardener screed:**
  - i. Hardtop to be prepared as per the specifications with Nito hardner and one part of dry cement.
  - ii. The heard top shall be provided over concrete base immediately after it is set, compacted and leveled with a steel trowel.
  - iii. The surface shall be trowelled to bring the hardener coat to a leveled surface.
  - iv. Excessive trowelling shall be avoided.
  - v. After the initial set, further compaction shall be done by steel trowelling.
  - vi. Final brushing shall be made before the floor top becomes too hard.

### **1.05 CURING:**

1. Curing shall commence as soon as the surface is hard enough to receive the water.
2. The surface shall be covered with sacks or sand and shall be kept continuously wet for a period of at least one week.
3. Groove cutting of size 6mm\*10mm shall be done on concrete surface for regulating shrinkage cracks ,panel size shall be approximately 50Sqm or as specified by the consultants

## **SECTION: STRUCTURAL STEEL (A – STL)**

### **1.00 STRUCTURAL STEEL**

#### **GENERAL**

#### **1.01 DESCRIPTION**

## Extent and Intent

The contractor shall furnish all materials, labour operation, equipment, tools and plant and incidentals necessary and required for the completion of all metal work in connection items of metal work as called for in the drawings. The drawings and specifications cover the major requirements only. The supplying of additional fastenings, accessory features and other items not mentioned specifically herein but which are necessary to make a complete installation shall be a part of the contract.

### a. WORKS INCLUDED

Anchorage in cast-in-situ concrete.

### b. RELATED WORK

- i. Grouting base plates and bearing plates
- ii. Metal fabricators
- iii. Roofing sheets

### References:

- a. IS-226-1975 - Structural Steel (standard quality) (fifth revision)
- b. IS-456-1978 - Code of practice for plain and reinforced concrete (third revision)
- c. IS-696-1972 - Code of practice for general engineering drawings (second revision)
- d. S-786-1967 - (Supplement) SI supplement to Indian Standard conversion factors and conversion tables (first revision)
- e. IS-812-1957 - Glossary of terms relating to welding and cutting of Metals
- f. IS-813-1961 - Scheme of symbols for welding
- g. IS-814 - Covered electrodes for metal arc welding of structural steels: 814 (Part 1)-1974 Part 1 for welding products other than sheets (fourth revision)
- h. IS-816-1969 - Code of practice for use of metal arc welding for general construction in mild steel (first revision)
- i. IS-817-1966 - Code of practice for training and testing of metal arc welders (revised)
- j. IS-819-1957 - Code of practice for resistance spot welding for light assemblies in mild steel
- k. IS-875-1964 - Code of practice for structural safety of buildings: Loading standards (revised)
- l. IS-919-1963 - Recommendations for limits and fits for engineering (revised)
- m. IS-961-1975 - Structural steel (high tensile) (second revision)
- n. IS-962-1967 - Code of practice for architectural and building drawings (first revision)
- o. IS-1024-1979 - Code of practice for use of welding in bridges and structures subject to dynamic loading (first revision)
- p. IS-1030-1982 - Carbon steel castings for general engineering purposes (second revision)
- q. IS-1148-1973 - Hot-rolled steel rivet bars (up to 40 mm diameter) for structural purposes (second revision)



r.	IS-1149-1982	-	High tensile steel rivet bars for structural purposes
s.	IS-1261-1959	-	Code of practice for seam welding in mild steel
t.	IS-1278-1972	-	Filler rods and wires for gas welding (second revision)
u.	IS-1323-1962	-	Code of practice for oxy- acetylene welding for structural work in mild steel (revised)
v.	IS-1363-1967	-	Black hexagon bolts, nuts and lock nuts (diameter 6 to 39 mm) and black hexagon screws (diameter 6 to 24 mm) (first revision)
w.	IS-1364-1967	-	Precision and semi-precision hexagon bolts, screws, nuts and lock nuts (diameter range 6 to 39 mm) (first revision)
x.	IS-1367-1967	-	Technical supply conditions for threaded fasteners (first revision)
y.	IS-1393-1961	-	Code of practice for training and testing of oxy-acetylene welders
z.	IS-1395-1982	-	Molybdenum and chromium molybdenum vanadium low alloy steel electrodes for metal arc welding (second revision)
aa.	IS-1477	-	Code of practice for painting of ferrous metals in buildings: 1477 (Part 1)-1971 Part 1 Pretreatment (first revision)(Part 2)-1971 Part 2 Painting
bb.	IS-1929-1961	-	Rivets for general purposes (12 to 48 mm diameter)
cc.	IS-1977-1975	-	Structural steel (ordinary quality) (second revision)
dd.	IS-2062-1984	-	Weld able structural steel (third revision)
ee.	IS-2155-1962	-	Rivets for general purposes (below 12 mm diameter)
ff.	IS-3613-1974	-	Acceptance tests for wire-flux combinations for submerged-arc welding of structural steels (first revision)
gg.	IS-3757-1972	-	High-tensile friction grip bolts (first revision)
hh.	IS-4000-1967	-	Code of practice for assembly of structural joints using high tensile friction grip fasteners
ii.	IS-5369-1975	-	General requirements for plain washers and lock washers (first revision)
jj.	IS-5370-1969	-	Plain washers with outside diameter 3 x inside diameter
kk.	IS-6419-1971	-	Welding rods and bare electrodes for gas shielded arc welding of structural steel
ll.	IS-6623-1972	-	High tensile friction grip nuts
mm.	IS-6649-1972	-	High tensile friction grip washers
nn.	IS-7205-1974	-	Safety code for erection of structural steel work
oo.	IS-7215-1974	-	Tolerances for fabrication of steel structures
pp.	IS-7280-1974	-	Bare wire electrodes for submerged arc welding of structural steels
qq.	IS-8500-1977	-	Weld able structural steel (medium and high strength qualities)

## 1.02 SHOP DRAWINGS

### INCLUDE

- a. Shop drawings for trusses, bracings, purlins, columns, ties, base plates, crane girders, etc.
- b. Indicate profiles, sizes, spacing and locations of structural members, connections, attachments, fasteners, cambers, loads and designs of joints.
- c. Indicate welded connections using standard welding symbols and net weld lengths.

- d. Indicate the method of erection, shop and field joints.
- e. Indicate and identify all transportable parts and sub assemblies, associates with special erection instructions, if any.
- f. Provide design calculations for splices, joints, other details not specifically detailed in design drawings on fabrication drawings considering standard detailing practices and developing full member strengths.
- g. Submit 3 sets of shop drawings to Project Manager for approval.
- h. Allow three weeks for Project Manager to approve Shop Drawings.

## **2.00 PRODUCTS**

### **2.01 Materials**

- a. Structural steel members.
- b. Structural tubing.
- c. Bolts, nuts and washers.
- d. Welding materials.
- e. Primer.
- f. Shear studs.

All metal materials shall be free from defects impairing strength, durability and appearance and they shall have structural properties that comply fully with the standards set out in clause 2.2, which follows. All ferrous metal shall be free from rust, scale and other defects. All non-ferrous metal shall have uniform finished surfaces, machined and buffed, free from defects. All sections shall conform accurately to sizes and shapes required.

### **2.02 Fabrication**

- a. Fabricate structural steel members in accordance with IS Specifications 800 Section V and approved shop drawings.
- b. Defective material used shall be replaced by the Contractor.
- c. Fabricated items delivered at site shall be suitably protected from any damages.

### **2.03 Finish**

- a. Clean, prepare and shop prime structural steel members. Do not prime surfaces to be field welded or bolted or in contact with concrete.

## **3.00 EXECUTION**

- 3.01
  - a. Erect structural steel in accordance with IS Specifications.
  - b. Make provision for erection loads and for sufficient temporary bracing to maintain the structure in proper plumb and in true alignment until completion of erection and installation of permanent bracing.
  - c. Do not field cut or alter structural members without approval of Project Manager.
  - d. After erection, prime welds, abrasions and surfaces not shop primed, except surfaces to be in contact with concrete.

- e. Members shall be cut mechanically by saw or shear or by oxy acetylene flame and not by electric metal arc.
- f. Cut edges shall be ground as per IS 823.
- g. Cutting tolerances shall be
  - 1.Members connected at bolt ends: + or - 1 mm.
  - 2. Other members: + or - 3 mm.
- h. All boltholes shall be drilled and to the sizes specified in drawings.
  - Tolerance for spacing between two holes: + or - 1 mm.
  - Tolerance between two perpendiculars of any oval hole: + or - 1 mm.
  - 3.Boltholes for field joints shall be drilled in the shop to the required diameters and tested.
- i. Drilling holes for standard sizes if varies can be reamed to next higher sizes. The tolerance for hole reaming shall not exceed 15% of the total number of holes for one joint.

### 3.02 Preparation of members for welding

- a. Proper jigs and fixtures shall be used to ensure correct positioning of structural members during assembly.
- b. Sharp edges, rusting of cutting edges, notches, irregularities, and fissures due to faulty cutting shall be chipped and ground.
- c. Edge preparation for welding shall be done properly taking care of cleaning, providing dry surface, removing grease, dust or dirt, foreign matter, etc.
- d. Finished dimensions of structure shall be ensured after taking into account the shrinkage and distortions during welding.

## 4.00 WELDING

### 4.01 Personnel:

- a. Welders shall be fully trained, experienced and certified by the recognised welding institutes.
- b. Welders' qualification tests shall be as per IS 823 and approved by Project Manager.

### 4.02 Execution:

- a. Welding shall be done in accordance with IS 823.
- b. Welded parts shall be marked with welders' identification.
- c. Protect the welded parts, electrode wires against wind and rain.
- d. Discontinued seams shall be melted before resuming welding operation.
- e. Welding seams shall be cooled slowly and not by any other quick methods.
- f. Before welding a second layer over the existing layer of weld, the layer shall be cleaned metal bright by light chipping and wire brushing.

### 4.03 Approval:

- a. Welded parts shall not have any deformations.
- b. Welded joints should compensate for contractions due to welding.
- c. Defective welds must be rectified.
- d. Weld seams shall correspond to design shapes and dimensions.
- e. Weld seams shall not have cracks, fusion, under cuts, rough surfaces, burns, blowholes, and incomplete penetration.
- f. Approval of finished elements, inspections and tests shall be as per Annexure

## **5.00 BOLTING**

### **5.01 Material**

- a. Bolts, nuts shall be in accordance with IS 1367 and tested as per IS 1608.
- b. Washers shall be as per IS 2016.

### **5.02 Preparation**

- a. Members shall be assembled for bolting with proper jigs and fixtures to sustain the assemblies without deformation and bending.
- b. All sharp edges, shavings, rust, dirt, etc. shall be removed before assembly.
- c. Before assembly the contacting surfaces of the members shall be cleaned and given a coat of primer.
- d. Temporarily the assembly shall be done and checked for co-axiality of the holes after which the assembly shall be finally bolted.

### **5.03 Execution**

Bolts shall be fixed after all the defects have been rectified and approved by Project Manager.  
Bolts shall be tightened from the centre of joint towards the edge.

### **5.04 Identification**

- Structural members prior to dispatch for erection shall be marked with a weather proof light coloured paint. The size and thickness of members shall be so chosen as to facilitate easy identification.
- Structural members small in size shall be bundled or crated and shall be marked with metal tags for bundles and painted on crates for identification with particulars of the bundle / crate size, weight, etc.

## **6.00 SHOP – APPROVALS**

### **6.01 PRE ASSEMBLY**

6.01.1 Pre assembly of bolted structures shall be done for all elements as well as for the entire structure in conformity with the 'holes for field joints'.

6.01.2 Steel structures having same type of welding the shop test pre assembly shall be performed at least one member out of ten members.

### **6.02 INSPECTION**

6.02.1 Contractor to provide facilities for Project Manager to inspect the steel assembly, welding, bolting, painting etc. at any time during fabrication of members.

6.02.2 Project Manager shall have the access to the fabrication shop at all times for satisfying himself regarding the fabrication of steel items to the drawings and specifications.

6.02.3 Shop approval by the Project Manager is only mandatory.

6.02.4 Contractor to bear all the expenses for testing required by the Project Manager for satisfying regarding the quality of workmanship.

6.02.5 Contractor to furnish necessary tools, gauges, instruments, technical and non-technical personnel for shop tests at his own cost.

### 6.03 Approvals

#### 6.03.1 Intermediate approvals:

- a. For part of the work that cannot be inspected later.
- b. For part of the work that will be difficult to perform inspection and even if done results are not satisfactory.

#### 6.03.2 Partial approvals:

- a. To the structural steel members and assemblies before the primer coat is applied.
- b. of materials used for fabrication.
- c. of test erection.
- d. of markings.
- e. of fillet joints.
- f. of plain surfaces.
- g. of special features such as rollers, etc.

#### 6.03.3 Final approval:

- a. To all elements and assemblies of steel structures after having a shop primer coat and ready for delivery.
- b. Includes partial approval
- c. Of shop primer coat.
- d. Of mode of loading and transport.
- e. Of storage of materials.

### 6.03.4 Approved Fabricators

All metal work shall be fabricated approved by the Project Manager. The entire work shall be carried out by workmen skilled in this kind of work in a shop fully equipped to carry out all phases of fabrication in accordance with the best-accepted trade practices.

### 6.04 PAINTING

#### 6.04.1 Preparation:

- a. Surface to receive primer coat shall be sand blasted / wire brushed, free of dust, oil, rust, etc.
- b. Surfaces not accessible to painting shall be filled with approved type of oil and putty.
- c. Surface shall be completely dry.
- d. Surfaces where water or aggressive agents may collect during transportation, storage, erection and operation shall be filled with putty and provided with drainage holes.
- e. Structural steel members are inspected and approved.
- f. Welds are approved.

g. After satisfying the above criteria the surfaces are to be provided with one coat of red oxide / zinc chromate primer to the satisfaction of Project Manager before the material is dispatched for erection.

6.04.2 Do not prime the following areas:

- a. Surfaces to receive weld at site.
- b. Surfaces bearing markings.
- c. Surfaces as indicated in drawings.
- d. Planned surfaces shall receive a coat of hot oil or any approved resistant lubricant only.
- e. To coat the surfaces with hot oil to holes for links.
- f. To give a coat of cement wash for any members either embedded or in contact with concrete.
- g. To give a bituminous coat for members in contact with ground, gravel, brickwork and moisture.
- h. Contractor to give a further coat of red oxide paint after erection and placing in position of the assembly if called for by the Project Manager.

#### **6.04.3 PACKING, TRANSPORTATION, DELIVERY:**

- a. Structural steel members shall be marked and approved in shop before packing and loading for transportation.
- c. Adequate packing must be done for all the steel members to protect them against warping during loading and unloading.
- d. Suitable lifting devices to be used for loading and unloading.
- d. Additional steel bracing to be provided for all slender projecting members to prevent any warping during transportation loading and unloading.
- e. Loading and transportation shall be done as per the transportation rules.
- f. To provide additional splice joints where required in consultation with Project Manager in case the members to be transported are beyond the limitations of transporting system.
- g. To secure all small parts including gusset plates fish plates by securing them with wire to their respective parts.
- h. To crate all bolts, nuts and washers.
- i. All structural parts to be delivered in the order required for construction and as per instructions of Project Manager and shall accompany the following documents.

1. Quality and quantity of structure or members.
2. Location of members in the structure
3. Description of structure
4. Identification number
5. Building/job symbol

#### **6.04.4 STORAGE AND PREPARATION OF MEMBERS PRIOR TO ERECTION**

- a. Place for storage of steel member shall be prepared in advance and got approved by the Project Manager.
- b. To provide concrete platform at the site for preliminary erection work.
- c. To verify the quality of material obtained at site and for workmanship to the specifications and drawings.
- d. To verify whether the parts obtained at site is free from defects due to loading, unloading transportation.
- e. To avoid warping of members during unloading by taking sufficient precautionary measures.
- f. To store the members as per the symbol and markings and in order of erection.
- g. To place the steel members at least 150mm above the platform on wooden or steel locks for protection against direct contact with ground and to permit drainage of water.
- h. To equip for rectification of members like straightening at site and to provide sufficient space for the same.
- i. To see that the parts are clean before erection.

#### **6.04.5 FIELD ERECTION**

- a) To get approvals of foundation, columns, column pedestals or other related structure on which the structural steel members are to be erected.
- b) To get approvals of the members receiving structural steel members regarding their levels, dimensions, alignments and verticality well in advance.
- c) To carry out any minor discrepancies at no additional cost.
- d) To get approvals of pockets, bolt locations, levels of base plates before erection.
- e) Erection to commence after satisfying the above conditions.
- f) Erection to be done in an organised way so that any individual member is not subjected to instability during the erection time.
- g) Precautionary measures to be taken during erection of trusses, purlins and other steel members by providing proper bracing.
- h) Faulty erections done without caring for safety of members and of personal shall be made good at no additional cost.
- i) Contractor is not relieved of his responsibilities, guarantees even after the Project Manager approves the fabrication, erection, etc., at any stage of work.
- j) Contractor is solely responsible for the correctness accuracy and quality of the fabrication, erection and final approvals to be obtained by the Project Manager.

#### **6.04.6 ERECTION AND TOLERANCE**

- a. To check and inspect before, during and after erection.
  1. Damage during transportation.
  2. Alignment of structure.
  3. Erection sequence
  4. Progress
  5. Workmanship
- b. To erect members as per the predetermined plan approved by the Project Manager.

- c. To position and level the structure including aligning and to plumb the stanchion and fixing every member in position with bolts, erection bolts, weld as per design and drawings.
- d. To inform the Project Manager of any variation, deviation in location of foundations, anchor bolts which shall deviate the prefabricated members.
- e. Project Manager to give suitable solutions in case of above deviations well in advance for the contractor to proceed with the fabrication of members including any modifications necessary.
- f. Contractor to rectify any minor deviations in foundations, location of steel bolts and orientation of bolthole positions at no extra cost.
- g. To erect structural steel members ensuring that the system is stable against inherent weight, wind and any erection trusses.
- i. To anchor and fasten the erection joints after duly checking the plan, elevation positions of the members with reference to the drawings after the approval of Project Manager.
- j. To fasten bolts to the final position with bolt heads and nuts resting on the member and on tapered washers with members having a sloping surface.

#### **6.04.7 FINAL ACCEPTANCE AND HANDING OVER THE STRUCTURE**

- a. Contractor to submit as built shop drawings either in tracings or reproducible drawings - 4 no. of copies.
- b. Documents to be submitted for final acceptance are as follows:
  - 1. Shop acceptance drawings
  - 2. Quality certificate for structural members, plates, flats, bolts.
  - 3. Quality certificate for material used for fabrication including electrodes, welding wire, bolts, nuts, washers, etc.,
  - 4. List of welders who welded the structures and their certificates for having undergone a welding course.
  - 5. Acceptance and intermediate control procedure adopted during the process of fabrication, assembly, transportation, delivery and erection of structure.

#### **7.00 MODE OF PAYMENT**

- d. Payment of structural steel members including bolts, nuts, washers, gusset plates, etc., will be done on weight basis.
- e. The weight of members will be assessed from the final fabricated and approved drawings and the respective bill of material prepared by the contractor and approved the Project Manager.



- f. The weight of members shall be as per IS handbook.
- g. Sections different than mentioned in IS handbook shall be taken as per manufacturers information.
- h. No rolling tolerance will be allowed.
- i. Built up of members will be paid as per the actual weight of the members.
- j. Gusset plates shall be paid to the nearest rectangle enclosing the shape and no deduction shall be made for any skew cuts.
- k. The rates for structural steel work to include all the welds, bolts, anchors, washers, etc., which are not measured separately and paid for.
- l. Payment do not include any other related temporary works connected with this work including welds, shims, wedge plates, etc.
- m. Rate to include any trimming, straightening, edge preparation, preparation of shop drawings, approval of shop drawings and one coat of red oxide / zinc chromate primer and also including any handling, rehandling, loading and unloading, transport to the site of work and returning surplus material to the Project Manager at the place requested by him.
- n. Rate to include necessary scaffolding, temporary support, tool and tackles, touching up primer coat grouting etc.,

#### 7.01 GROUTING

- a. To level, align and plumb the structural steel work and the base of stanchions by providing steel shim plates.
- b. To align anchor bolts in foundation to the required level, location and orientation by using templates.
- c. To clean the underside of base plates, pockets to receive grout by using compressed air.
- d. To use cement mortar 1:2, 1 of cement and 2 of sand, non-shrink grout under base plates.
- e. To use grade M 30 concrete to fill up the grout pockets left for fixing anchor bolts.
- f. To pour the grout under a sufficient head and tam until the voids are thoroughly filled and the grout overflows.

#### 7.02 TOLERANCES

- a. Steel work for line and level + or - 3mm
- b. For structural steel for plumb 3.5mm for 10M  
and not more than 7mm for 30M
- c. To follow any tolerance criteria provided on the drawings.
- d. To provide tolerances for all structural steel members as per IS code other than what is mentioned in a, b and c.

**ANNEXURE - A**

Inspection of test	Coverage	Procedure	Evaluation findings & remedy of Defect
Inspection of weld seam	All welds	Naked Eye or Lens	All faulty welds shall be rectified
Checking of Sizes	At least one for each Weld	Ordinary measuring instruments (rule, templates)	Should faulty weld be found all welds shall be checked & all defects shall be rectified.
Mechanical tests for welding procedure performance & electrodes		As per IS: 823	

**ANNEXURE - B**

INADMISSIBLE WELD DEFECTS AND TOLERANCE ALLOWED FOR WELDS

Defects	Detailing of sketching of defect. defects	Allowed tolerances & remedy of	cause of defects	mode of finding defects
Unsatisfactory appearance	Uneven width rugged seam	At discretion cut weld & re-weld	Uneven welding progress, voltage fluctuations, varying arc Length, negligence inexperienced welder.	External (visual) inspection.
Unsatisfactory shape	Shallow or jutting welds shape shall be allowed.	no variance from design	negligence	Visual inspection template checking

Incomplete weld		Not allowed fill in weld		Template checking
Molten metal flow		Not allowed fill in weld wrong	Excessive melting, ions. handling of electrodes.	Visual inspections
Pits	Not allowed cut & reweld	Wrong welding		Visual inspection technique
Surface cracks		Not allowed cut & reweld  wrong type	Grerat stresses, sudden cooling, of electrodes.	Visual inspection.
Incorrect Sectional Dimensions A) Depth		B1=+or- 2 mm B2=+or- 2 mm B =+or- 1 mm C =+or- 1 mm	Negligence	Temple checking
Weld	Chisel & grind.			
Insufficient lengths	For weld  11+5 mm, for 12+10 mm for shorter seams cur & reweld or complete to length.	Negligence	Rule	Checking
Back cuts	If 0.5 mm for 10 mm & C 1 mm  for 10 MM replace relevant		Burnt material,	Visual inspection  excessive melting

members

Surface porosities	Max. 5% of seam area cut & re-weld	Frequent interruptions welding	Visual inspections or electrodes inadequately covered
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Inadequate appearance of weld may be allowed if no other defects that might diminish weld strength are present. Sectional weld shape must comply with design indications. No concave welds shall be allowed for specified convex welds, or vice versa. Tolerance for concavity or convexity of welds shape be 1 x A ("A" being the height of the triangle within the section shown), but more than 0.6 mm.

**SECTION : MISCELLANEOUS WORKS ( A – MIS)**

- ANTI TERMITE TREATMENT
- ADMIXTURES AND ADDITIVES TO CONCRETE WORKS
- GROUTS
- PRECAST CONCRETE
- WATERPROOFING
- EXPANSION JOINTS
- LAMINATED NEOPRENE PAD

**1.00 ANTI TERMITE TREATMENT**

**1.01 SPECIFICATIONS FOR ANTI TERMITE TREATMENT**

All the buildings shall be adequately protected against attack by sub terrain termites by suitable chemical treatment measures. The work shall be carried out by a specialist pest control agency approved by the Project Manager. The work to be carried out by the specialist firm shall carry a guarantee for the satisfactory performance of the treatment for a min. Period of ten (10) years.

The treatment shall be carried out generally in accordance with the stipulation laid down by IS 6313 - Part II latest edition (Code of practice for anti termite measures in buildings and part II re constructional chemical treatment measures) subject to the min. Requirement given in this specification.

**1.02 MINIMUM SPECIFICATIONS**

The earth filling immediately under the stone soling (under floors) bottom and side fills of all foundations (excepting foundations) and soil along external perimeter of all buildings shall be chemically treated against termites. The chemical to be used for the treatment shall be Dildrin, Aldrin, Heptachlor or Chlordane or as specified conforming of the requirement and concentration laid down in IS 6313 (Part II) - latest edition.

**1.03 APPLICATION**

The chemical solution shall be prepared by mixing the chemical with the appropriate quantity of water to obtain a chemical emulsion of the correct concentration as stipulated above. The prepared emulsion shall be applied as described below.

#### 1.04 COLUMN PITS, WALL TRENCHES, ETC.

The bottom surface and sides of the excavations (up to a height of 30cm from the bottom) made for column foundations, wall foundations etc., (excepting RCC foundations) shall be treated with the chemical emulsion at the rate of 5 ltr/m<sup>2</sup> of surface area.

#### 1.05 TREATMENT TO BACKFILL

After the column foundations, wall foundations etc., are constructed, the back fill in immediate contact with the foundation structure shall be treated at the rate of 15 ltr/m<sup>2</sup> of the surface of the substructure for each side if water is used for ramming operation completely by rodding earth at 15cm centers close to the wall face and spraying the chemical with the above dose. The earth shall be filled in layers and the treatment shall also be carried out in similar stages. The chemical emulsion shall be directed towards the masonry wall surfaces so that the earth in contact with these surfaces is well treated with the chemicals.

In the case of RCC walls and columns, the treatment shall start at the depth of 50 cm. below natural ground level.

From this depth the back fill around the RCC columns, walls, etc., shall be treated at the rate of 15 ltr/m<sup>2</sup> of the surface.

#### 1.06 TOP SURFACE OF PLINTH FILLING

The top surface of the plinth fill (just below the stone soling) shall be treated with chemical emulsion at the rate of 5 ltr/m<sup>2</sup> of the surface before the stone lay. If the filled earth has been well consolidated and does not permit the emulsion to seep through, holes up to 50 to 75mm deep at 150mm centers both ways may be made with crowbars to facilitate saturation of the soil with the chemical emulsion.

#### 1.07 JUNCTION OF WALL AND FLOOR

A channel size of 3x3 cm shall be made at all the junction of walls and columns with the floor (before laying soling) and rod wholes made in the channels up to the ground level at 15cm centers. The solution is poured into the channels at the rate of 15 ltr/m<sup>2</sup> of the vertical surface and allowed to soak through the holes fully so that the soil in contact with the chemical. The soil shall be tamped back into the channel and consolidation to the original conditions.

#### 1.08 EXTERNAL PERIMETER OF BUILDING

After the building is complete, holes shall be made along the external perimeter of the building at intervals 15cms and depth of 30cms and the emulsions shall be allowed to soak through these holes fully at the rate of 5 ltr/m<sup>2</sup> of the perimeter wall.

#### 1.09 SOIL SURROUNDING PIPES

Wherever any service pipes enter the soil inside the area of the foundations of any building, the solid surrounding the point of entry of each pipe at the foundation, floor etc., shall be fully soaked with the chemical solution for a distance of at least 1mtr. from the point of such entry.

#### 1.10 EXPANSION JOINTS

Soil beneath the expansion joints at ground floor level shall be specially treated as directed. The joints itself shall also be treated as directed by the Project Manager.

### 1.11 TREATMENT UNDER APRON

The soil below the concrete for stone aprons to be provided around the perimeter walls of all buildings shall also be treated with the chemical solutions at the rate of 5 ltr/m<sup>2</sup>.

### 1.12 TREATMENT OVER DPC

Top of concrete damp proof course in external and internal walls shall be given a liberal coat of chemical solution when the concrete is still green.

### 1.13 SPRAYING EQUIPMENT

To facilitate proper penetration of the chemical into the soil, a pressure pump of adequate capacity and sprayers shall be employed to apply the solution.

### 1.14 MEASUREMENTS

The measurements shall be made in m<sup>2</sup> on the basis of plinth area of the building at ground floor only for all operations described in schedule of quantities. Nothing extra shall be measured.

### 1.15 RATE

The rate shall include the cost of all materials and labours involved in all the operations described above including making holes and refilling and making good the same.

## 2.00 ADMIXTURES AND ADDITIVES

Chemical admixtures are not to be used until permitted by the Project Manager. In case their use is permitted, the type, amount and method of use of any admixture proposed by the contractor shall be submitted to the Project Manager for approval.

The contractor shall further provide the following information concerning each admixture to the Project Manager.

Normal dosage and detrimental effects, if any, of under dosage and over dosage.

The chemical names of main ingredients in the admixture

The Chloride iron content, if any, expressed as a percentage by weight of admixture.

Whether or not the admixture leads to the entrainment of air when used in the manufacturer's recommended dosage.

Where two or more admixtures are proposed to be used in any one mix, the manufacturer's written confirmation of their compatibility.

In reinforced concrete, the chloride iron of any admixtures used shall not exceed 2 percent by weight of the admixtures in accordance with IS 6925 and the total chloride iron in all admixtures used in concrete mix shall not exceed 0.03 % by weight of cement

The admixtures when used shall conform to IS 9103 "The suitability of all admixtures shall be verified by trial mixtures".

The addition of calcium chloride to concrete containing embedded metal will not be permitted under any circumstances.

Retarding admixtures when used shall be based on lingsulphonates with due considerations to IS 7861

Water proofing admixtures shall comply with IS 2645.

## 3.00 GROUTS

### 3.01 GROUTING

Grouting shall be done in 1:2 cement mortar (one part cement and two parts coarse sand) of thickness 3” (75mm) or less, or as directed. Where the thickness is more than 3” (75 mm) thick grouting shall be done in plain or reinforced cement with coarse aggregate 3/8” and down gauge. The mix of concrete will be as shown in the relevant drawings as directed.

The base plate shall be temporarily supported on steel wedges and properly aligned before grouting. Forms shall be built around the base and wet mortar shall be placed under pressure around and under the base. To ensure that no air pockets are left after grouting additions holes may have to be cut if directed in the base plate so that pressure grouting can be carried out thorough these holes also and proper inspection of the grout can be ascertained. The wedges shall be removed after the grouting has set and recess shall be properly pointed.

Grouting of machine foundations shall be done only after taking the written instructions form the Project Manager.

The grouting work is included in the respective item of concrete and the rate for these items and inclusive of proper pressure grouting after preparations of surfaces to be grouted, necessary form work providing and removing necessary wedges, cutting holes in the base plate to ensure that the air pockets are left etc. No extra rate will be paid for grouting or any work that will be necessary to carry out and ensure proper grouting entirely to the satisfaction of the Project Manager. If however a concrete mix richer than the foundation is specified for grouting, only the difference of the quantity of cement used in richer mix of grout and the mix of the footing shall be paid.

### **3.02 SPECIAL GROUTS**

Where so specified non-shrinking grouts such as ‘Conbextra’, ‘shrinkkomp’ or ‘Ferro grout’ shall be used as per the instructions and specifications of the manufacturers.

## **4.00 PRECAST CONCRETE**

### **Work includes**

- a) **Precast kerbs**
- b) **Precast posts/panels**
- c) **Precast lintels**

### **4.01 PRECAST NOMINAL MIX CONCRETE**

#### **General**

All precast concrete shall be cast over vibrating tables or by using form vibrators. The concrete mix shall conform in all respect to “ Various Concretes” described in the appropriate paragraph under this section.

Exposed precast surfaces shall be finished as called for on the drawing or as directed by the Project Manager. All surfaces coming in contact with in situ concrete shall be wire brushed and hosed down until the aggregate is free form cement slurry. Castellation shall be provided wherever called for. Leaving grouting holes, grooves, inserts, projections reinforcements, lifting hooks etc., to conform to the erection procedure. All edges and delicate projection likely to be damaged during erection shall be protected by means of wooden cover fillets, until placed in position.

### **4.02 PRECAST JALI BLOCKS LOUVERS, SHELVES, ETC.**

All precast jali shall be exactly of the size and pattern shown on the drawings and shall be made face up in the following manner. All units shall be integrally cast, steel formwork shall be used for making jalis.

Provided in the formwork as shown in the drawings. Stiff plastic concrete 1:1.5:3 shall be used with coarse aggregate 12mm and down size.

The precast units shall not be removed from the forms for three days. Precast work shall be cured under cover and shall be kept under water for fifteen days before placing in position.

Samples of each part shall be approved by the Project Manager before proceeding with the work.

Unit may require wetting before bedding. The concrete base shall be wetted and coated with slurry and minimum of mixing water shall be used in the bedding mortar, which shall be Portland cement and sand 1:3.

The section shall apply also to prestressed precast controlled concrete work.

For all precast controlled concrete work a specially equipped site factory, with casting yard, pretensioning beds of individual moulds for vibrating plants, cement store, concrete laboratory erection equipment, etc., are to be provided. The contractor is deemed to have included in his rates all the above provisions needed for a workman like construction in precast controlled concrete.

All precast design mix concrete shall be weigh batched.

#### 4.03 PLACING AND COMPACTING OF CONCRETE

All precautions in handling and placing of high strength concrete mixes apply. The concrete placed shall be compacted thoroughly by using pin, vibrators, shutter vibrators or other suitable means. No construction joints shall be allowed in precast design mix concrete work. Unshuttered top surface are to be finished smooth with trowel.

During the period of initial setting special precautions are to be taken to keep precast members sufficiently moist to protect them against vibrations and any adverse loading.

### 5.00 EXPANSION JOINTS, WATER STOPS, PREMOULDED JOINT FILLERS, FLASHINGS

#### 5.01 EXPANSION JOINTS

Expansion joints shall be provided with 20 gauge copper strips/m.s. hot dip galvanised strips of 250 mm width at locations shown on drawings or as approved by Project Manager. The strips shall be bent to the shape indicated on the drawing and embedded properly in masonry. The joint width shall be uniform throughout and special care shall be taken to ensure proper bonding at expansion joints. Expansion joints shall be continuous and where two or more strips meet, they shall be lapped to the extent of 75 mm and joints properly soldered. The expansion joints shall be filled with pre moulded joint fillers and sealed with mastic compound. For purposes of measurement, the laps provided will be neglected. Wherever an expansion joint between the existing part and new part is proposed the rate quoted shall be inclusive of making necessary connections with existing part.

#### 5.02 WATER STOPS

Water stops shall be of Performed plastic adhesive of approved make. These shall be provided at locations indicated on drawings. Water stops shall be lapped 100 mm and heat sealed to obtain continuity. Water stops shall be cleaned thoroughly of all concrete and mortar coating as directed before resuming concrete work. Water stops shall be in long lengths to avoid joints as far as possible.

#### 5.03 JOINT FILLER



Premoulded joint fillers shall be of a non-deteriorating and resilient type. A sample of material shall be approved by the Project Manager before being brought to site. Installation shall be carried out properly and as directed.

**5.04 FLASHINGS**

Metal or tar felt flashing shall be fixed as directed by the Project Manager. Metal flashing where provided shall be welded/ soldered to obtain continuity. Tar felt flashing shall be lapped for a minimum length of 150 mm.

Flashing shall be measured and paid for in linear metres for the specified width disregarding laps or joints.

**7.00 SPECIFICATION FOR LAMINATED NEOPRENE PAD**

7.01 The scope of this specification shall apply to laminated free elastomeric bearings.

7.02 Material

7.02.1 Chloroprene shall only be used in the manufacture of bearing.

7.02.2 Grades of raw elastomer of proven use in elastomeric bearings, with low crystallisation rates and adequate shelf life (e.g. Neoprene, WRT, Bayprene 110 or equivalent) shall be used. No reclaimed rubber or vulcanised wastes shall be used.

7.02.3 The raw elastomer content of the compound shall not be lower than 60%. The ash content shall not exceed 5% (as per test conducted in accordance with ASTM D-297)

**7.03 Properties of Elastomer**

7.3.1 The elastomer shall conform to all properties specified in the following table.

Sl.#	Property	Unit	Test method I.S specification reference	Value of the characteristic specified.
1.0	Physical properties			
1.1	Hardness	IRHD	IS : 3400 (Part II)	60 ± 5
1.2	Minimum tensile strength	Mpa	IS : 3400 (Part I)	17
1.3	Minimum elongation at break	%	IS : 3400 (Part I)	400
2.0	Maximum compression set	%	IS : 3400 (Part X)	
			Duration (h)	Temperature

				(C)	
	C.R.		(+0 to 24-2)	100 ± 1	35

Sl.#	Property	Unit	Test method I.S specification reference		Value of the characteristic specified.
3.0	Maximum compression set	%	IS : 3400 (Part IV)		
			Duration (h)	Temperature (C)	
	C.R.		(70)	100 ± 1	
3.1	Maximum change in hardness	IRHD			+ 15
3.2	Maximum change in tensile strength	%			- 15
3.3	Maximum change in elongation	%			- 40

7.3.2 Shear modules of the elastomer bearing shall not be less than 0.8Mpa nor greater than 1.20Mpa.

7.3.3 The adhesive strength of elastomer to steel plates (determined as per IS 3400: Part XIV method A) shall not be less than 7 kN/m

#### 7.4 Design parameters of elastomer bearings.

7.04.1 The thickness of all internal layers of elastomer "h<sub>i</sub>" shall be as specified in the Bill of Quantities.

7.04.2 Thickness of outer layers shall be  $h_e = h_i/2$  subject to a maximum of 6mm and side cover shall be 6mm for all bearings.

7.04.3 Elastomer bearing shall satisfy the criteria enumerated in Clause No. 916.3.3, 916.3.5 & 916.3.6 of IRC 83 (Part II) - 1987

#### 7.05 Fabrication

7.05.1 Bearing with steel laminates shall be cast as a single unit in a mould and vulcanised under heat and pressure. Casting of elements in separate units and subsequent bonding is not permitted nor shall cutting from large size cast be permitted.

7.05.2 Bearings of similar size shall be produced by identical process and in one lot as far as practicable.

7.05.3 The moulds used shall have standard surface finish adequate to produce bearings free from any surface blemishes.

7.05.4 Steel plates for laminates shall be sand blasted, clean of all mill scales and shall be free from all contaminants prior to bonding by vulcanisation. Rusted plates with pitting shall not be used. All edges of plates shall be rounded.

7.05.5 Spacers used in mould to ensure cover and location of laminates shall be of minimum size and number practicable. Any hole at surface or in edge cover shall be filled in subsequently.

7.05.6 Care shall be taken to ensure uniform vulcanising conditions and homogeneity of elastomer through the surface and body of the bearing.

7.05.7 The bearings shall be fabricated with the tolerance specified in the following table.

Sl.No.	Items	Tolerances
1.	Overall plan dimensions	-0, +6mm
2.	Total bearing thickness	-0, +5%
3.	Parallelism	
a.	Of top surface of bearing with respect to the bottom surface as datum.	1 in 200
b.	Of one side surface with respect o the other as datum	1 in 100
4. a.	Thickness of individual internal layer of elastomer	± 20% (max of 2 mm)
b.	Thickness of individual outer layer	- 0, + 1mm
5. a.	Plan dimensions of laminates	-3mm, +0
b.	Thickness of laminate	± 10%
c.	Parallelism of laminate with respect to bearing base as datum	1 to 100

7.05.8 The vulcanising equipment press should be such that between the platens of the press the pressure and temperature are uniform and capable of being maintained at constant values as required for effecting an uniform vulcanisation of the bearing.

7.05.9 The moulding dies utilised for manufacturing the bearings should be so set inside the platen of the press so that the pressure development during vulcanisation of the product is evenly distributed and the thickness maintained at all places is within acceptable tolerance limits taking into consideration, the shrinkage allowance of vulcanization.

7.05.10 The raw compound which has been introduced inside the metal dies for vulcanisation should be accurately weighed each time and it must be ensured that sufficient quantity has been put inside the die for proper flow of material at every place so that a homogeneous and compact bearing is produced without any sign of sponginess or deficiency of material at any place.

7.05.11 Before any vulcanizate of any batch of production is used for producing vulcanised bearings, test pieces in the form of standard slab and buttons should be prepared in accordance with prescribed standards

and salient properties tested and recorded regularly against each batch of production to monitor the quality of the products.

#### **7.06 Quality Control Certificate**

7.06.1 The manufacturer shall certify for each lot of bearing under acceptance:

- a. That an adequate system of continuous quality control was operated in his plant.
- b. That the entire process remained in control during the production of the lot of bearings under acceptance as verified from the quality control records / charts which shall be open to inspection of the Project Manager on demand.

7.06.2 A certified copy of the results of process control testing done on samples of elastomer used in the production of the lot shall be appended and shall include at least the following information.

7.06.3 Composition of the compound- raw elastomer and ash content, the grade of raw elastomer used (include name, source, age on shelf), test results of hardness, tensile strength, elongation at break, compression set, accelerated ageing etc.,

#### **8.00 GALVALUME SHEET ROOFING**

**The Pre Painted Galvalume (PPGL)** Sheets used for roofing shall be usually 0.35 to 0.6mm thickness and to be as per the details given in the drawings. Alu-Zinc coating: AZ150 Standard. AZ100, AZ70 and higher Alu-Zinc coatings optional. The coil, sheet and effective width shall be as per the required standards and Tensile strength: 550 Mpa Standard. 245~400 Mpa optional Standards met: ASTM A755, JIS 3322, AS1397, and IS277.

The painting shall be as per the regular standards, Silicon Modified Polyester (SMP) & PVF2 if required and optional as per the requirements. The colour shall be as required though there are generally six optional wide range of colours are available.

**PPGI (Pre Painted Galvanized Iron) GI Base**, will be of the same thickness, Z120 Standard. Z100 and higher Zinc coatings optional, of tensile strength 245~345 Mpa Standard, of standards ASTM A653, JIS 3312, IS277, AS 1397, All the other standards and things are as mentioned above for PPGL.

**NCGL ( Non Colour Galvalume or Bare Galvalume Alu Zinc coating ) GI Base**, 0.4 to 0.6mm thickness, Alu Zinc Coating corresponding to AZ100, AZ70 and higher Alu-Zinc coatings optional, Tensile Strength Standard. 245~345 Mpa, to meet the standards as per ASTM A792, AS 2728, IS277. Others as per the details mentioned above.

The thickness of the sheet to be decided on the dead and live load factors.

**Packing, Storage and Handling:** Keep the product dry and clear off the ground on wooden blocks. Do not slide the sheet over rough surface. If sheets are wet, wipe with clean cloth. Roofing & Cladding sheets should be erected as soon as possible on arrival at the job site. In case of temporary storage, the same should be stored in-doors. In case of outdoor storage, the sheets have to be covered with tarpaulin.

For cutting the sheets, the usage of knibbler is recommended. The cut materials and metal particles are required to be swept from the ground. Failure to do so will lead to rusting or surface staining. Fixing of screws

recommended with Torque adjustable guns. For roof work, fix screws on the crest. For wall cladding, fix on the crest or on the valley. Fasteners to confirm to AS 3566 Class 3 - 4 for external application.

**Annexure-C**

**TECHNICAL SPECIFICATIONS**

**FOR**

**ARCHITECTURAL WORKS**



**Architectural finishing works**

<b>01.00</b>	<b>Masonry works .....</b>	<b>03</b>
<b>02.00</b>	<b>floor finishing works .....</b>	<b>10</b>
<b>03.00</b>	<b>plastering works .....</b>	<b>20</b>
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## **FINISHING WORKS**

### **01.00 MASONRY WORK**

#### **Scope**

This specification covers the general requirements for masonry works like stone masonry, brick masonry, concrete block masonry and allied works including all materials, labour, curing, scaffolding, tools and equipment etc.

#### **Materials**

Cement  
Refer general specification

Fine Aggregate  
Refer general specification

Water  
Refer general specification

#### **Mortar**

Cement, sand and water shall be as specified. Cement and sand shall be mixed in specified proportions, sand being measured in measuring boxes. In case of damp sand, its quantity may be corrected for bulk age. The mortar for brick masonry shall be 1:6 or as specified. The mortar for half brick walls shall be of 1:4 proportions. The proportions will be by volume on the basis of 50kg bag of cement being equal to 35 litres (about 1.2cft), the mixing of mortar shall be using mechanical mixer. However, hand mixing may be allowed only on approval of the Engineer / Employer.

#### **Preparation of Mortar**

Machine mixed mortar shall be prepared in an approved mixer. About 5 percent to 10 percent of mixing water shall be put into the mixer; sand and cement in the required proportions shall be then added. The remainder of water, quantity of which required shall be predetermined by consideration of strength and consistency and shall be added uniformly. Mixing will be continued until all particles of sand are uniformly coated with cement paste. Mixing for 1.5 to 2 minutes will normally be sufficient. Water – cement ratios will be as per IS codes or as directed by the Employer / Engineer.

In hand – mixed mortar, cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times till a homogenous mixture of uniform colour is obtained. Fresh and clean water as specified above shall be added gradually through a hose and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be complete covered with film wet cement. The Water-Cement ratio shall be as per IS codes or directed by the Engineer / Employer.

Mixing platform shall be so arranged that no deleterious and extraneous material shall get mixed with mortar nor the mixing water of the mortar shall flow out. The mortar so



prepared shall be used within 60 minutes of adding water. Only such quantity or mortar shall be prepared as can be used within 60 minutes. The mortar remaining unused after that period or mortar which has partially hardened or is otherwise damaged shall not be tempered or remixed. It shall be destroyed or thrown away.

### **Size Stone Masonry Works**

#### **Stones**

Stones used in masonry shall generally conform to IS: 1597. The stones shall be sound, durable, free from flaws, cracks, injurious veins sand holes, cavities, and patches of soft loose materials and shall taper to a point. The percentage of water absorption shall generally not exceed 5%. The stone shall be kept free from dirt, oil, grease or any other injurious material, which may attack the stone or mortar or prevent adhesion of mortar. Stones with skins shall not be used. Generally, the stone should not contain crypt crystalline silica, or chert, mica or any other deleterious material like iron oxide, organic impurities etc., and the type shall be as specified. The strength of stones should be adequate to carry loads imposed. Table 1 of IS 1597 gives the minimum crushing strength of approved stone. Minimum strength shall be 200kg / sqm unless specified otherwise.

#### **Dressing of Stones**

This in general shall conform to IS: 1129. For Random Rubble Masonry, stones shall be hammered at the face, the sides and beds to enable it to come close to with the neighboring stone, the bushing on the face shall be 4 cm on all exposed face. For Coarsed Rubble Masonry, the bed and top shall be dressed square to the face and rough tooled to 100 mm (about 4") from the face and vertical joints similarly dressed to 40 mm (about 1.5") from the face. In the embedded portion the length of the side shall not be less than that of the exposed side opposite by more than 80 mm (about 3") for the longer and the shorter side.

#### **Face & Backing Stones**

These shall be chiseled dressed top and bottom, true and square for at least 50 mm from the face and the rest of the width shall tail into the work and shall not project below or above the plane of dressing. No stone shall tail to a point. The vertical joints shall be chisel dressed for a depth of not less than 40 mm from the face. Individual stones shall have their thickness and width of not less than 150 mm in its thickest part and no stones shall have its length less than 1.5 times its height. The face stones and backing stones shall be selected from the mass of quarry stones for their greater size, good beds, close grain and uniform colour. 50 percent of the stones shall be more than 0.010 cum (about 0.353 cu ft) in thicker walls.

#### **Through Stones**

One through stone shall be provided per half square meter of facing evenly distributed. They shall be about 0.03 Sqm (about 1/3 Sft.) in face and shall have a tailing of the full width of the masonry when the width is 600 mm (above 2") or less. If the wall or masonry be over 600 mm (about 2 feet) in width, line of headers, overlapping each other by at least 150 mm (about 6 ") shall be laid right through the wall from face to back. The length of the interior headers shall not be less than 450 mm (about 18") and their average cross sectional area shall not be less than 0.25 Sqm (about 1/4.ft.). Face header shall be

distinctly marked on its face.

#### **Vertical Headers**

For the massive work with a width of a meter (about 3.38 feet) and above, vertical headers 450 mm (about 18") long or depth of two courses whichever is more shall be provided at the rate of one for every sq. meter (about 10.76 sq ft.) of area in plan. For every course a new set of headers shall be introduced at this rate in a staggered pattern. Their average sectional area shall not be less than 0.03 Sqm (1/3 sq ft.)

#### **Hearting Stone**

These can be rubble stones. In walls of 500 mm (about 20") and less, about 30 percent of the stones shall not be less than 0.10 Cu.mt. (about 1/3 cu ft) and for thicker walls about 30 percent of stones shall not be less than 0.15 Cu.mt or (about 1/2 cu ft). The hearting stones shall be hammer dressed on the top and bottom beds. A small proportion of spalls and chips can be used to fill the hollows between the sides of the hearting stones in each course so as to avoid thick mortar joints. However, spalls shall not be used for making up the height of hearting to that of the course.

#### **Quions**

These shall be of selected stone and shall normally be 200 mm x 250 mm x 400 mm (about 8" x 10" x 16") or as directed by the Engineer. The faces of quions shall be rough tooled or provided the same type of dressing as that of the face stones as directed. Chisel draft of about 40mm (about 1 1/2") shall be provided on each side of the exposed corner.

Different categories of stones such as face stone, backing stone, hearting stone, headers, quions, etc, shall be collected in advance so as to suffice at least for week requirements and shall be stacked separately category-wise.

#### **Construction:**

The masonry shall be laid to lines, levels, curves and shapes. All iron fixtures, pipe outlets, holdfasts for doors and windows, stone, concrete or other fixtures, plugs, frames etc., if any, shall be built and bonded as directed by the Engineer / Employer as the work proceeds and not inserted or joggled on after the masonry is advanced. Holes of the required size and shape shall be left in the Masonry during construction itself for fixing pipes, service lines or for passage of water. After the service lines, pipes, etc., are fixed extra hollow left if any shall be filled with 1:4:8 cement concrete and the face shall be neatly finished with matching stones. If any fixtures are to be provided, they shall be neatly embedded in the required position while laying the masonry. Iron fixtures shall be embedded in 1:4:8 cement concrete.

Stones in hearting shall be laid on their broadcast face, which gives better opportunity to fill the space between stones. Stratified stones must be laid on their shall be wetted before laying in mortar. The bed, which is to receive the stone, shall be cleaned, wetted and covered with a layer of fresh mortar. All stones shall be laid full in mortar both in bed and vertical joints and settled carefully in place with a mallet immediately on placement and solidly bedded in mortar before it has set.

Clean chips and spalls, carefully selected to fill in the space shall be wedged into the mortar

joints wherever necessary to avoid thick joints of mortar. In case any stone already set in mortar is disturbed or the joint broken the stone shall be taken out without disturbing the adjoining stones and joints, the mortar thoroughly cleaned from the joints and the stone reset with mortar. Attempts must never be made to slide one stone over another already laid.

Shaping and dressing shall be done before the stone is laid in the work. No dressing and hammering which will loosen the masonry will be permitted after it is once placed. There shall be good collection of stones and sepals within easy reach of mason to enable proper selection of stones for individual locations while laying. The stones shall be continuously replenished.

The face stones and backing stones shall be laid without any pinnings on the exposed faces. In each course the headers or lines of headers, as the case may be shall be kept, in position at specified intervals and with specified laps, where such laps are required before the masonry of the layers is commenced to ensure that they are being laid properly and in required number and intervals. They shall be embedded in mortar as masonry in that layer progresses.

Quoins shall be laid stretcher and header wise as seen on each face and shall correspond to the arrangement of quoins in the same course. The quantity of mortar for 1 cubic meter of thin and missive masonry shall range from 0.30 cum to 0.35 cum respectively and for water retaining masonry from 0.46 cum to 0.48 cum.

The Size stone masonry shall be cured for a minimum period of 7 days.

#### **Bond**

##### Lateral Bond

To give sufficient lateral bond, a stone in any course shall break joint with the stone in the course below or above about half the height of the course and generally not less than 80 mm. (about 3") i.e. joints parallel to the pressure in courses above and below shall not lie too closely near the same vertical line.

##### Transverse Bond

To give sufficient transverse bond, the prescribed number of headers shall extend from front to back of thin walls upto a width of 600 mm (about 2') or prescribed number of lines of overlapping headers from face to back to walls over 600 mm (about 2' thick). Over laps shall be 150 mm (about 6") at each end. To ensure provision of full number of headers of the required sizes, they shall be kept at specified intervals in each course in advance of starting masonry and then embedded in mortar. Their position in each course shall be staggered, so that each will be near about the middle in the courses below and above. Their faces shall be marked with a distinguishing sign to identify them.

##### At junctions

To bond work at all angles and junctions of walls, the stones at each alternate course shall be so carried into each of the respective walls as to join the work thoroughly. Quoins shall be laid header and stretcher wise when seen on each side of the wall.

##### With old work

When new work has to be started on the old or one completed a long while ago or in the previous working season, care shall be taken to roughen and clean masonry before laying the new. It shall be wetted before laying bedding mortar.

Where practicable the whole of the masonry in the stretcher shall be carried up to a uniform level throughout. But where breaks are unavoidable in carrying the work continuously in horizontal courses, sufficiently long step shall be left to join the courses to be laid later. All junctions of wall shall be formed at the time the walls are being built; cross walls should be carefully bonded into the main walls. The practice of building two thin faces tied with occasional through stones and spalls and putting mortar on top must be strictly guarded against. Putting dry chips in the joints of stones before filling them with mortar shall be left uneven at the top of each course. But the top of the plinth and verandah walls shall be leveled up with flat chips laid in mortar, if necessary, to receive damp proof course coping etc.

### **Joints**

No face joints shall exceed 16mm (about 5/8")

#### **Striking Joints**

The face shall be properly struck while the mortar is fresh. Joints which cannot be so struck at the time of laying, shall be prepared for it by raking joints to a depth of not less than 16mm (about 5/8") when the mortar is fresh. These joints should be properly cleaned of loose particles, wetted thoroughly and filled with good fresh cement mortar 1:3 and finished off by being trawled smooth.

#### **Treatment of Joints**

When the joints are to be pointed they shall be raked to a depth of not less than their width when the mortar is still green. When the pointing is not to be done, the mortar in the joints shall be pressed and trawled smooth while masonry is being laid. Joint as shall be raked when plastering is to be done.

#### **Cut Stone or Moulded Stone Work**

This specification refers to ornamental carved stone work in cornices, string courses, copings and the like.

- The stones used shall be granite, of approved quality and colour, hard and free from defect of any kind as specified for Ashlar faced Masonry.
- The stones shall be dressed to a profile as shown in working drawings and checked with a template cut out of 14 gauge GI sheets.
- The exposed faces of the stones and joints 6mm from the face shall be fine dressed with a chisel (3 line dressing) and all joints shall be in line and not more than 3mm thick. All visible angles and edges shall be free from unsightly chipping. Beds and joints shall be dressed as per specification of Ashlar Faced masonry.
- Cornices, coping, etc., shall be in as long length as are easily obtained but not less than 1.2 mt. They shall break joint with the stones or the course below.
- String courses, cornices etc., shall tail into the work to such depth as specified or as directed by the Engineer / Employer.
- Quoins shall be laid header and stretcher in alternative courses and shall ordinarily be of the full height of a course.
- Mortar used shall be fine cement mortar 1:6.

- The stone shall be protected by rough planking during progress of work where exposed to damage.
- Relevant specifications for Ashlar Masonry work shall apply.

### **Brick Masonry**

Bricks shall be sound, hard, well-burnt, uniform in size, shape and colour, homogenous in texture, giving a metallic ringing sound, free from flaws, cracks, holes, lumps or grit and arises should be square, straight and sharply defined. They shall not break when struck against each other and dropped flat from a height of 1 m to the ground. Maximum water absorption shall not be more than 20% of its dry weight on immersion in water for 24 hours. Minimum compressive strength shall be 35 kgs / sq cm if not specified in the BOQ. They shall conform to Table 1 of IS 1077 giving classes of common burnt clay bricks.

Bricks shall be obtained from an approved source and sample approved prior to procurement. Bricks used for masonry work shall be soaked in water by immersing it for at least 6 hours before use. At the time of laying, the surface shall be just moist but not too wet to cause dripping of water.

Bricks of approved quality and quantity shall have to be procured by the contractor at the desired time. No delay or extra cost due to non-availability shall be accepted. The contractor is obliged to carry out the work as specified. It shall be the responsibility of the contractor to procure sufficient quantities of bricks and stack them at site or elsewhere to avoid delays.

### **Mortars**

The mortars for brick masonry shall be CM 1:6 or as specified. The mortar for half brick walls shall be of CM 1:4 proportions.

### **Workmanship**

Bricks used for masonry work shall be soaked in water by immersing it for at least 6 hours before use. At the time of laying, the surface shall be just moist but not too wet to cause dripping of water.

In mud and fat-lime mortar brick masonry, bricks shall not be soaked.

Bricks shall be laid in English bond with frog upwards, unless otherwise specified. Half or cut bricks shall be used only for the purpose of bond and at no other place. Cut bricks shall be allowed in work.

Work shall be true to horizontal lines and perfect plumb. Vertical joints shall be truly vertical and those in alternate courses shall be in the same vertical line. Joints of each course shall be within the limit of 6mm to 10mm depending upon the size of bricks. Total height of 9 cm brick with 5 courses and 5 mortar joints shall be 50 cm. In no case shall joint thickness of horizontal and vertical be more than stated above. Joints should be filled to full depth and checked each time. Prior to start of work it must be noted and checked that bricks on top are full-size bricks (flat or brick on edge). To achieve this, precautions should be taken from the start of the first layer. Thickness of joints shall be so adjusted so as to have full bricks on top. Also it must be noted and checked that all horizontal joints on

every floor are at the same level, as to allow proper bonding at junctions.

Required datum levels must be established throughout the floor and only then should work start.

It is equally important to take into account levels of windows sills, lintels, etc. while finalizing courses and joint thickness and the decision of the Employer regarding providing brick on edge, concrete sills, etc., shall be final.

In addition, for convenience and speed, gauge boards of exact width shall be fixed at the edges of masonry to correct line and plumb. These boards shall be marked with course levels to achieve exact height of each course and full bricks at the top.

One or half brick thick wall shall have minimum one face in true plumb.

It is imperative to raise the brickwork uniformly over complete work joined together. If this is not possible, raked brickwork shall be done at 45 degrees to the vertical. Tothing shall not be accepted.

All iron fixtures, pipe outlets, hold - fasts for doors and windows shall be fixed when the brickwork is in progress. It must be embedded in cement mortar or concrete as specified or as directed by the Employer. Required treatment to fixtures shall be carried out prior to embedding.

Joint thickness shall be provided as discussed above. Joints shall be filled to full depth before second course is laid. Frogs shall be upward at all times. Joints shall be raked back to a minimum 10 to 15 mm while the mortar is green. Surface of brickwork shall be cleaned with coil string, wire brushes, etc. to keep the surface free for the next operation. All dropped and spoiled mortar, brickbats, etc. shall be cleared from the floor before work is closed for the day. The brick masonry shall be cured for a minimum period of 7 days.

### **Types of Brickwork**

#### **Walls 230mm thick or more**

Walls of 230mm thickness or more shall be constructed with approved and selected bricks. Mortar shall be as specified in the BOQ.

Points discussed above shall be followed for workmanship.

Brick wall of 230mm thickness shall be constructed from one side and one face shall be true and plumb. Thicker walls shall be constructed with masons on both faces and both the faces shall be true and plumb.

#### **Half brick work – plain or reinforced**

Half brick walls shall be constructed wherever shown in the detailed drawing prepared by contractor. These shall be all of stretchers only and half bricks shall not be used. The mortar to be used shall be cement sand mortar 1:4 and as per specification mentioned elsewhere. The work shall be carried out as per IS: 2212.

Reinforcement consisting of 2 bars of 6mm shall be provided after every fourth course, the MS bars shall be well anchored at the ends of the partition. These bars shall be fully embedded in mortar and overlaps if any shall be minimum 300 mm and shall conform to specifications mentioned under 'Steel Reinforcement'

Whenever the height of the walls is more than 2.0M and R.C.C runner shall be provided if so instructed by the Engineer, at the rate of one runner for every 1.5m height the R.C.C that shall be paid separately. But the reinforcement in the brickwork shall be included in the rate for the brick masonry.

Care shall be taken to see that the wall is not disturbed till it is fully set. All scaffolding, shuttering and formwork for R.C.C work connected to the newly built wall shall be constructed with utmost care so that the stability of the wall is fully secured. While making the shuttering for the R.C.C runner, nailing planks to the wall shall not be permitted. While curing, the water is to be sprinkled by a hose to the wall and not by throwing and splashing across the wall.

#### **Hollow, Cellular and solid block work**

Hollow, Cellular or solid concrete blocks shall conform to IS 2185 and shall be regular in size and shape and of the specified strength. They should be manufactured by an approved agency, having mechanized machinery. The Contractor shall supply samples for the approval of the Engineer and all blocks supplied shall conform strictly to the approved samples.

The materials for all blocks shall be mixed upon a clean mixing platform or in an approved mechanical mixer and shall be gauged with sufficient water to enable the materials to bind together under pressure and therefore placed in the block making machine in layers not exceeding 75 mm, each layer being thoroughly tamped or, if approved, machine vibrated. On removal from the machine the blocks shall be protected from the direct rays of the sun in an approved manner and kept open without protection. Each batch of blocks shall be marked in a distinguishing manner. Blocks shall be properly cured before being brought to Site and shall have a texture such that plaster and/or render will readily adhere to it. Half or three quarter size blocks may be used wherever required to make up lengths of walls but broken blocks shall not be used. All blocks shall be left with good sharp clean edges. All blocks not approved by the Engineer shall be immediately removed from the site at no cost to the employer and replaced by satisfactory blocks. Unload and handle blocks carefully without chipping or damaging.

The equipment used in the manufacturing shall be regularly cleaned to ensure proper profiling of blocks.

Whenever the height of the walls is more than 2.0M and R.C.C runner shall be provided if so instructed by the Engineer, at the rate of one runner for every 1.5m height the R.C.C that shall be paid separately. But the reinforcement in the brickwork shall be included in the rate

for the brick masonry

**Mortars**

The mortars for block masonry shall be CM 1:6 or as specified.

**Workmanship**

Block work shall be plumb, square and properly bonded with broken joints. The thickness of the courses shall be uniform with courses horizontal. All connected work shall be carried out at one level and no portion of the work shall be left more than one course lower than the adjacent work. The Size stone masonry shall be cured for a minimum period of 7 days.

Blocks shall be laid so that all joints are well filled with mortar. Joints shall not be less than 6mm and not more than 8mm thick. Face joints shall be raked to a minimum depth of 10mm by raking tools during the progress of work when the mortar is still green so as to provide a proper key for pointing, plastering or rendering. When pointing, plastering or rendering is not required joints shall be struck flush.

For pointed blockwork or blockwork without plaster or render approved, smooth textured concrete blocks shall be used.

Faces of blockwork shall be cleaned daily and all mortar droppings cleaned off and removed. Top surfaces of each course shall be thoroughly cleaned before other courses are laid. If mortar in lower courses has begun to set joints shall be raked out to a depth of 12mm before laying is continued.

Where blocks are to be used for load bearing walls the uppermost course of blocks supporting slabs or other structural members shall be solid or treated as directed by the Engineer.

Miscellaneous inserts in blockwork, e.g. sleeves, wall ties, anchors, conduits, structural steel, steel lintels and the like shall be installed by the Contractor and these items shall be deemed to be included in the quoted rates for blockwork. The supply of such inserts by the Contractor will be paid separately in accordance with the relevant items of the Bill of Quantities.

Openings, arches, chases, pockets and the like shall be provided as required to receive windows, louvers, doors frames and the like.

Wall ties and flashing shall be built into blockwork in accordance with the drawings and Specifications. It shall be clearly understood that the rates quoted by the Contractor shall be deemed to include for leaving openings, Forming arches, cutting chases pockets and the like in blockwork for various trades.



## **02.00 FLOOR FINISH**

### **Scope**

This specification describes the general requirement of all types of flooring works including all materials, labour, tools & plants, scaffolding, curing, testing, protecting, maintaining, and completing in all respects as stated below. Flooring, as herein specified, shall be applied to all surfaces requiring flooring or finishes as specified throughout the interior and exterior of the buildings as called for.

### **Material**

#### **Cement**

Refer general specification

#### **Fine Aggregate**

Refer general specification

#### **Coarse Aggregate**

Refer general specification

#### **Water**

Refer general specification

### **Samples**

Samples of all flooring materials shall be submitted to the Employer/ Architect for approval, and all slabs procured shall fully match the samples.

### **Preparation of base surface**

For all types of flooring and skirting the base, base concrete, structural slab, masonry wall, concrete wall etc. to receive the finish shall be adequately roughened, joints raked, thoroughly cleaned of all dirt, grease, loose particle, caked mortar droppings, and laitance, if any by scrubbing with coir or steel wire brush before the operation of laying the topping is started. Where the concrete is hardened so much that roughening the surface by wire brush is not possible, the entire surface shall be roughened by chipping or hacking and the skin removed. The surface shall be thoroughly cleaned and soaked with water, at least for twelve hours and the surplus water shall be removed by mopping immediately before the topping is laid in position.

### **Workmanship**

The commencement, scheduling and sequence of the finishing works shall be planned in details and must be specifically approved by the Engineer, keeping in view the activities of other agencies working in the area. Workers especially experienced in particular items of finishing work shall carry out the work. Where such workers are not readily available, experienced supervisors recommended by the manufacturer shall be engaged with the prior permission and based on approval of the Engineer. In particular cases, Engineer may

desire the installation of finishing items by the manufacturer. The Contractor shall make this arrangement

## **Granolithic flooring**

### **General**

This specification relates to the furnishing of the component materials that are to form the Granolithic topping, preparation of the concrete from these materials and laying the same in the finish or topping over an already laid base concrete.

### **Materials**

As the floor topping referred to in these specifications is in the form of cement concrete, the materials and preparation of the floor finish shall be as laid down under general Specification, Concrete for plain and reinforced works, the mix shall be as specified in the BOQ.

### **Construction / Workmanship**

The operation of laying the topping shall commence with fixing of screed strips over the base concrete dividing into suitable panels so as to reduce the risk of cracking. Size of panel is governed by the thickness of the floor finish, the type of construction (monolithic or bonded construction), local conditions of temperatures, humidity and the season in which the floor is laid. For floor finish laid in exposed situations or in hot and dry climate, the size of the panels shall be smaller as compared to the floor finish laid in less exposed situations or in cold humid climates. Generally, no dimension shall exceed 2m in the case where the floor in finish is laid separately on a hardened base; the length of the panel shall not exceed 1.5 times its breadth. The thickness shall not be less than 40mm. Side Formwork for panels shall be only structural steel sections.

The limits with regard to the dimension of panels (normally 7.5 mt sq.) shall also apply to borders and skirting laid around the floor. The joints in the floor finish shall extend through the borders and skirting. If the skirting is laid monolithic with the floorings a border of about 300mm width must be provided all around the floor. The width of border provided around the floor when the skirting is not monolithic with floor finish shall not exceed 450mm. Rows of panels shall be staggered to an extent of about 300mm to avoid the corners of the adjacent panels meeting at one point.

The screed strips shall be so arranged that the joints, if any, in the base concrete shall coincide with the joints in the topping. Before placing the concrete mix for topping, neat cement slurry shall be thoroughly applied on to the prepared surface of the base concrete.

The topping shall be laid in alternate panels, the intermediate panels being filled in after two to three days depending upon the temperature and atmospheric conditions. Longer intervals shall be preferred to allow the concrete topping in the panels laid first to complete its initial shrinkage and to attain sufficient strength to allow tamping to the topping in the new panels without damaging the edges of panels laid earlier.

The screed strips shall be removed a few hours after the concrete has been deposited in the panels and the edges of panels shall be examined for any honeycombing or

undulations, which if found, shall be repaired straight and smooth by cement mortar. The screed strips shall then be cleaned and put back against the edges of panels deposit. When the topping is to be deposited in the alternate panels the screed strips shall be removed and the edges of panels laid earlier shall be covered with paper strips and alike, laid vertically and folded over the surface of panels already laid, to prevent the new topping from spoiling the edges. When the topping is being concreted in new panels, care shall be taken to avoid damages to the panels already laid.

The topping laid as indicated above shall be thoroughly tamped, struck off level, and the surface floated with a wooden float. The surface shall be tested with a straight edge and masons spirit level or any other equipment approved as equivalent by the Engineer / Employer to detect any inequalities in the surface, which, if any, shall be made good immediately.

After topping is thoroughly tamped, vibro floated and struck off level, etc., as indicated above it shall be finished by trawling. Finishing operations shall start shortly after the compaction of the topping and shall be spread over the period of one to six hours depending upon the temperature and atmospheric condition. The surface shall be trawled three times at intervals so as to produce a uniform and hard surface.

The satisfactory resistance of floor to wear depend largely upon the care with which trawling is carried out. The object of trawling is to produce as hard and close knit a surface as possible. The time interval allowed between successive trawling is to produce as hard and close knit a surface as possible. The time interval allowed between successive trawling is very important. Immediately after laying, only just sufficient trawling shall be done to given a surface. Excessive trawling in the earlier stages shall be avoided, as this tends to work a layer rich in cement to the surface. Some time after the first close any pores in the surface, and to bring to surface and scrap off any excess water in concrete or laitance (it shall not be trawled back into the topping). The final trawling the surface shall be done such a time after the first trawling the surface will be re-trowelled to close any pores in the surface, and to bring to surface and scrap off any excess water in concrete of laitance (it shall not be trawled back into the topping). The final trawling shall be done well before the concrete has become too hard but at such time that considerable pressure is required to make any impression on the surface. Trawling of rich mix of dry cement and fine aggregate onto the surface shall not be permitted. Ramps shall be given serrated finish.

### **Skirting**

Granolithic skirting to walls 100 to 150 mm high, shall be as called for on the drawings, recessed or flush with the finished wall surface as called for on the drawings. The skirting shall be 20mm thick, consisting of one part cement and four parts screened sand, applied to wall faces, compacted and trowelled smooth with a floating coat of neat cement to a finish approved by the Employer / Architect to match with the granolithic floor. The junction of the skirting with floor to be neatly rounded to a radius of 20 mm. The surface shall be kept constantly wet for ten days. Skirting shall be of the same topping concrete of flooring for a height as specified shall perfectly match with the flooring.

### **Vacuum de-watering**

De-watering shall be done by using vacuum pumps by suction method and the top should be finished using skim floaters/ discs/ power trowels to the required slope and levels. Over and above hardtop shall be provided using approved floor hardener at the required consumption as per the approved manufacturers specification.

The fresh concrete surface shall be covered with 200-micron thick polythene sheet soon after finishing.

## **Stone Work**

### **General**

The item relates to the requirements of finishing materials and installation of polished stone tile work. The types of work that are mainly intended under this head are Granite, Marble, Kota stone, Dholpur stone, Agra red stone, Tandur, shababad or Cuddappah stone slabs in flooring and wall facing.

### **Materials**

Stones shall be the best quality available in the locality and of specified colour. The stones shall stand weathering and wet well and when immersed in water for 24 hours shall not absorb more than 5 % of its dry weight, when tested according to IS 1124. All stone shall generally be freshly quarried and shall not have any streaks or flaws and shall be free from discoloration oil or any unwanted matter that may prevent adhesion or mortar or be otherwise harmful to the work. Particular attention shall be paid to uniformity of colour and matching patterns and grains. The thickness shall be specified in the detailed specifications. All Stones shall be as approved by the Architect / Engineer.

### **Construction / Workmanship**

The tiles shall be machine cut to specified sizes and shall be of approved colour & quality. They shall be of specified thickness and laid to patterns as directed. The floor surface to be tiled shall be thoroughly brushed and scrubbed and profusely watered and cleaned. Cement mortar for bedding shall be 1:6 for flooring and 1:3 for cladding, as specified and shall be not less than  $\frac{3}{4}$ " (20mm) thick.

Immediately each stone is laid it shall be tapped with a wooden mallet and set joints even with no depression or mounds as per levels indicated and joints shall be in line. Joints shall be grouted with cement mortar of matching colour with the tiles. The tiles surface shall be kept wet and allowed to set for 14 days. No traffic shall be allowed over newly set tiles for at least 3 days.

### **Protection**

All work should be covered with a layer of Plaster of Paris with a layer of paper to avoid scratches, impressions etc.

After the work has set, the surface shall be finally polished with Oxalic acid to the satisfaction of the Employer / Architect.

### **Granite slab Works**

All supplied granite should be cut mechanically before laying. All work should be covered with a layer of Plaster of Paris with a layer of paper to avoid scratches, impression etc.

#### **Machine Polished Stone flooring work.**

Polished stonework consists of installation of pre polished / factory polished slabs / tiles in flooring and skirting over a layer of cement mortar as specified in the drawing / BOQ. The type of works that are mainly intended under this head are Dholpur stone, Agra red stone, Granite stone slabs in flooring and skirting.

Every stone shall have the top surface machine polished before brought to the site. All stones shall be machine cut to the required sizes and all edges ground smooth and even to the full depth. A straight edge laid along the side of the slab shall be in full contact with it. All angles and edges of the slabs shall be true and square and free from chipping.

#### **Granite and Marble Bands**

Where called for, granite and marble stone shall be laid in bands and borders of required widths as called for on the drawings. Such borders and bands will be having its length uniform width as called in the drawings shall merge with the level of the flooring / cladding. Slabs for treads and risers shall be of single lengths to cover the full width of steps. Treads shall project slightly beyond the face of the riser as called in the drawings Round off edge / provide bull nosing as shown and provide 3mm deep grooves for grip, over full length of tread. Risers to rest on the treads, slightly slanting as shown in the drawings. Treads and risers shall be fixed to cement mortar (1:4) base screed with tile adhesive as described earlier. Cement mortar shall be 20mm thick, mixed and laid as described earlier. Marble sills in toilets etc shall be 20mm thick with all visible faces and edges polished. Finished work shall be true to line and levels. Cleaning, washing, protecting, etc shall be as described earlier.

#### **Shahabad, Tandur, Kota and Cuddapah Flooring**

Shahabad, Tandur, Kotah and Cuddapah flooring shall consists of installation of such flooring stone in flooring and skirting over a layer of cement mortar as specified in the BOQ to the requirements as described below.

#### **Material**

Stones shall confirm to the relevant IS specifications and workmanship to IS: 1143. The slabs shall be of selected quality, hard sound, dense, homogenous in texture, free from cracks, decay, weathering and flaws and shall be of thickness as specified. The top exposed faces should have been roughly polished before bringing it to site. Unless otherwise specified the slabs should be cut to the required shape and size, by machine as specified. All pieces should be of uniform color. The size of the tile and pattern shall be as specified in the drawing.

#### **Laying, Raking and Cleaning**

The surplus cement grout that may have come out of the joints has to be wiped off gently and joints shall be raked and cleaned. The joints shall be filled up with white cement with

an admixture of pigments to match the shade of the slab. The tiled surface shall be kept wet and allowed to set for 14 days. Polishing will be rough, medium, nice, acid wash and tin-oxide finish as per Industry manufactures specification and as approved by the Engineer. One coat of polishing has to be carried out before handing over.

### **Skirting**

The height and the type of the skirting shall be as given in BOQ. The skirting stones shall be fixed to the wall by chasing the wall plastering to accommodate the base mortar. The stone shall be cut to the required size and should be polished once before fixing. Polishing should also be done by hand held machine after the fixing, when sufficiently set. Fixing of stone tiles, racking, cleaning and joint filling shall be done similar to the floor tiling. The stone skirting can also be done with necessary adhesives of approved makes instead of bed mortar.

### **Marble flooring**

Marble flooring consists of installation of such flooring and skirting over a layer of cement mortar of proportion as specified in the BOQ.

### **Materials**

Marble slabs and tiles shall be as per IS: 777 & workmanship as per IS: 1443. Slabs of approved shade, variety, size and thickness shall be used. They shall be of selected quality, dense, uniform and homogeneous in texture and free from cracks or other structural defects. The exposed face shall have no veins or unsightly stains and defects. They shall have uniform milky white or coloured shade or patterns of colours approved by Engineer. The surface shall be fine polished and side's machine cut, true to square. Every stone must be machine cut to a specified size in any direction and chisel dressed on all sides so as to be free from waviness and to give truly vertical, horizontal, radial and circular joints as required. The sides and top surfaces of marble slabs shall be machine rubbed with coarse sand before using. Marble slabs in borders, joints and soffits of entrances, openings and skirting shall be in full width. Marble slabs in treads and risers of steps shall be in single pieces with rounded edges or angular edges as may be described. All the exposed edges of these are to be machine cut and polished smooth along with exposed faces.

### **Laying**

The surface preparation shall be done as given in the above sections

Flooring slabs will be set in cement mortar of proportion and thickness as specified in the BOQ to the slope and level as directed by the engineer. The surface should be kept slightly rough to form a satisfactory key for the tiles.

Neat white cement paste of honey like consistency shall be spread over mortar bed at 3.3 Kg/sq.m over such an area, so that the paste will not harden before laying tiles. The marble slabs shall be pressed on to them firmly. Alternatively, the tiles can be fixed using tile adhesives with the prior approval of the engineer.

Cavities if any, shall be filled with a thin grout of white cement mortar of the same proportion. When the void cannot be filled with grout on detection of "hollow sound"

while tapping, the slab shall be removed and reset to the complete satisfaction of the Engineer.

The finished surface should be truly to the level/slope required.

**Racking cleaning and polishing**

Same as described in the above section using the materials for this type of flooring.

**Skirting**

Skirting work shall be similar as described in the above section.

**Marble Flooring**

Crazy marble flooring consists of installation of such flooring over a layer of cement concrete of proportion as specified in the BOQ.

**Materials:**

Marble slabs shall be as per IS: 777 & workmanship shall be as per IS: 1443. The mix of crazy marble stone flooring shall consist of white cement with or without pigment, marble powder, marble chips and marble stone pieces and water. The marble stone pieces shall be hard, sound, dense and homogenous in texture with crystalline and coarse grains. It shall be uniform in colour and free from stains, cracks, decay and weathering. Before starting the work the contractor shall get the sample of marble stone approved by the Engineer. The marble stone pieces shall be of sizes as approved by the Engineer, but the thickness shall be according to the overall thickness specified which could be achieved when laid over the under layer as specified. Thus for 50 mm thick floor, the thickness of marble pieces will be 25 mm while for 40 mm thick floor, the thickness will be 15 mm.

**Laying**

Crazy marble stone flooring shall be laid on cement concrete base. The base concrete shall be provided with slope required for the flooring in verandahs and courtyards to drain the water away.

The surface preparation shall be done as given in section 03.01.01 and smeared with a floating coat of cement slurry at 2 kg per sq.m so as to get a good bond between base and flooring

The white cement and marble powder shall be mixed in proportion of three parts of cement and one part of marble powder by weight, and the proportion of marble chips to binder mix by volume shall be 7 parts of marble chips to 4 parts of binder mix.

A coat of cement slurry at the rate of 2 kg of cement per sq.m of area shall be spread and then the marble stone pieces shall be set by hand in such a manner that the top surface of all the set marble stones shall be true to the required level and slopes.

After fixing the stones, the cement marble chips mixture shall be filled in between the gaps of laid marble stone pieces. The filled surface then shall be trowelled over, pressed

and brought to the level of the laid marble stone pieces.

The surface shall be hand polished if suitable machine is not available. The edges, junctions and corner shall be rounded off to a uniform radius if directed. The finished surface should show the marble chips evenly.

The final polishing, oxalic acid shall be dusted over the surface at the rate 33gm/Sqm, Sprinkled with water and rubbed hard with nemdah block (pad of woolen rags). The following day, the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean. Curing should be done by ponding water or by other means for a period of 14 days.

### **Glazed Ceramic Tile**

Glazed ceramic tile flooring consists of installation of glazed ceramic tiles in flooring and skirting over a layer of cement mortar of mix of specified proportion in the BOQ to the requirements given described below.

#### **Materials**

The Tiles shall conform to IS: 777 and workmanship shall be as per IS: 1443. The mortar shall be in the proportion as specified in the BOQ. The body of glazed ceramic tiles should consist of high grade clay and minerals and should be highly pressed, single fired, red body, top glazed white or coloured, plain or with designs as directed by the Engineer and shall be at least 6mm thick. The tiles shall be of first quality of any approved manufacturer. The size of the tile shall be as specified by EIC. Glazed rounded corners and cups shall be provided at corner of walls, edges, junctions of floor and dado etc. The top surface shall be glazed with stable gloss / semi gloss / matt finish of uniform colour and texture and it shall be free from flaws, cracks, chips, craze, specks, crawling or other imperfections. These shall be sound, true to shape with true and straight edges, non-absorbing and non-fading. The edges and the underside of the tiles shall be completely free from glaze so that these may adhere properly to the surface below.

Tiles should have high strength, good resistance to wear and tear, low water absorption and sufficient antiskid properties. Based on the properties of the glaze and their hardness, floor tiles are categorized by abrasion resistance wise from Group-II to V. According to the intensity of foot traffic, the tile group shall be selected and used as given below.

1. Group II – In areas with medium foot traffic, to be trod on with leather or rubber footwear.
2. Group III - In areas destined to frequent foot traffic with medium abrasion.
3. Group IV - In areas destined to a strong passage and intensive foot traffic with heavy abrasion.
4. Group V - Floor tiles having very high Abrasive Resistance shall be used for areas destined to high intensive foot traffic with heavy abrasion.

The size of the tiles shall be as indicated by TSPL EIC.



### **Laying**

The base surface preparation shall be done as given in section 03.03.04.

The prepared surface shall be plastered rough to a thickness as specified in the BOQ with cement Mortar mix as specified in the BOQ. Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer fairly rigid cushion for the tiles to be set in. If the proportion of the cement mortar is not specified a mix of CM 1:4 shall be used.

Over this cement mortar bedding neat grey cement slurry of honey like consistency shall be spread @ 3.3Kg/sq.m.of area. Before fixing the tiles, the bed mortar shall be roughened by scratching diagonal lines at close intervals. Tiles shall be soaked in water for 2 hrs prior to fixing and washed clean. The tile shall be fixed in cement grout, pressed and tapped with a wooden mallet taking care that the joints are perfectly matching. Joints shall be kept to minimum. Alternatively, the tiles can be fixed using tile additives with the prior approval of the Engineer.

The surface of the flooring shall be checked with a straight edge about 2m long to obtain true surface with the required slope. Where full sized tiles cannot be fixed these shall be cut to the required size by power saw and the edges rubbed smooth to ensure straight and true joints.

### **Raking and cleaning**

After the tiles have set, joints shall be raked and cleaned off the cement slurry with coir brush or trowel to a depth of 2-3 mm and the tile joints shall be flush pointed with white cement mixed with “Roff rainbow Tile Mate” or approved equivalent to match the colour of tiles as per manufacturers specification. The surface shall be carefully wiped off before it sets. Care shall be taken to ensure that the finished surface is to proper levels without any profusion waviness or zigzag. Joints between tiles shall be uniform in straight levels and lines. After completion of the entire work or part of it, the surface shall be cleaned of all stains, cement etc., by washing with mild hydrochloric acid and clean water or any other approved compound. The floor shall be kept wet for 7 days. The finished floor shall not sound hollow when tapped with a wooden mallet.

### **Skirting**

The height and the type of the skirting shall be as given in BOQ. Ceramic tile skirting shall be fixed to the wall by chasing the wall plastering to accommodate the base mortar. The skirting can also be done with necessary adhesives of approved makes instead of bed mortar. Fixing of tiles, racking, cleaning joint filling shall be done similar to the floor tiling.

### **Vitrified Tiles**

Vitrified (unglazed) ceramic unpolished/polished tile flooring consists of installation of such tiles in flooring and skirting over a layer of cement mortar as specified in the BOQ to the requirements as described below.

### **Material**

The Tiles shall conform to IS: 4457 and workmanship shall be as per IS: 1443. The tiles shall be homogeneous and compact through out the entire body with very high strength, low porosity and extreme surface hardness, high resistance to abrasion, resistant to chemicals etc. The tiles shall be sound, non-absorbing flat and true to shape with straight edges. The tiles shall possess smooth surface or textured anti-skid finish surface. The tiles should be free from any warping, deformation any chipping and any scratches. The tiles shall be in absolute level. The under side of tiles shall have ribs or indentations for better anchorage with the base mortar / adhesive as specified. Polished vitrified ceramic floor tiles shall possess highly reflective polished surface but it should be non-slippery.

#### **Laying, Raking and Cleaning**

Same as described in the above section using the materials for this type of flooring.

#### **Skirting**

The height and the type of the skirting shall be as given in drawing /BOQ. Vitrified tile skirting shall be fixed to the wall by chasing the wall plastering to accommodate the base mortar. The stone skirting can also be done with necessary adhesives of approved makes instead of bed mortar. Fixing of tiles, raking, cleaning joint filling shall be done similar to the floor tiling.

#### **Cement Colour tiles**

Cement colour tiles consist of installation of such tiles in flooring and skirting over a layer of cement mortar as specified in the drawing/BOQ to the requirements as described below. Tiles shall conform to IS: 1237 and workmanship to IS: 1143

#### **Material**

Cement tile to be used for external and internal applications shall be manufactured using very high quality raw materials, high strength cement, colour pigments etc. to withstand all conditions of extreme intensity in terms of temperature, vagaries of the nature, traffic, extreme heat and cold etc. The tiles shall be heavy, dense, and homogeneous in texture with high strength and surface hardness, high resistance to abrasion and low porosity.

Tiles of approved make, colour, design, plain, chequered or grooved pattern etc. shall be used as directed by the Engineer. All tiles procured should be exactly as per approved samples. Tiles shall be procured from a single approved source. The size of the tile and pattern shall be as specified in the drawing.

#### **Laying, Raking and Cleaning**

Same as described in section 03.01.03 using the materials for this type of flooring.

#### **Skirting**

The height and the type of the skirting shall be as given in drawing /BOQ. Cement colour tile skirting shall be fixed to the wall by chasing the wall plastering to accommodate the

base mortar. The stone skirting can also be done with necessary adhesives of approved makes instead of bed mortar. Fixing of tiles, racking, cleaning joint filling shall be done similar to the floor tiling.

### **Terrazo tiles**

Terrazo (mosaic) tile consists of installation of such tiles in flooring and skirting over a layer of cement mortar as specified in the drawing/BOQ to the requirements as below.

#### **Material**

Tiles shall conform to IS: 1237 workmanship to IS: 1143. Marble Mosaic Tiles (Terrazzo Tiles) shall be of the colour and pattern approved by the Engineer and the size shall be normally 25cm x 25cm or as specified in the drawing /BOQ. They shall conform to IS: 1237 in respect of constituent materials, manufacture, shape, dimensions, tolerances, wearing layers, colour and appearance, general quality, strength, resistance to wear, water absorption etc.

#### **Laying**

The base surface preparation shall be done as given in section 03.03.04.

A bed of cement mortar as specified in drawing/BOQ shall be laid properly to levels of average thickness as described in the drawing/BOQ .The surface should be kept slightly rough to provide a key for the tiles.

Tiles should be soaked in water for 15 minutes and allowed to dry for an equal amount of time before being laid.

Neat cement paste of honey like consistency shall be spread over the mortar bed over such an area as would be covered by about twenty tiles.

The tiles shall then be coated with a thin coat of cement paste on the back and fixed in place and gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints between tiles shall be paper fine.

After the tiles have been completely laid in a room or a days work completed, surplus cement paste that has come out of the joints should be wiped clean. A thick slurry of colored cement, matching the colour of the tiles is then spread over the laid tiles and rubbed so as to seal even the thinnest joint between the tiles. The floor shall be cured for 14 days. The floor shall be polished and finished in accordance with IS: 1443.

After final polish, oxalic acid shall be dusted over the surface, sprinkled with water and rubbed hard with a pad of woolen rags. The following day the floor shall be wiped with a moist rag.

If any tile is disturbed or damaged, it shall be refitted or replaced. The finished floor should not sound hollow when tapped with wooden mallet, in which case the affected tile

shall be removed and refitted to the complete satisfaction of the Engineer at the cost of the contractor.

#### **Skirting**

The height and the type of the skirting shall be as given in the drawing /BOQ. Terrazzo Mosaic tile skirting shall be fixed to the wall by chasing the wall plastering to accommodate the base mortar. The stone skirting can also be done with necessary adhesives of approved makes instead of bed mortar. Fixing of tiles, racking, cleaning joint filling shall be done similar to the floor tiling.

#### **Granite counter**

Granite counter refers to providing and installation of approved pre polished granite slab for toilet / kitchen washbasin counter / platform

#### **Materials:**

Same as described in the section for Granite flooring works.

#### **Laying / Fixing:**

The Counter shall be fixed on MS brackets anchored from block masonry walls or laid over a bed of CM (1:4) over a concrete platform. Grooves of depth 40mm shall be cut along the wall and the Granite sunk into the groove and the grooves grouted using CM (1:4). The surface shall be raked and finished using white cement.

The Counter Granite shall be provided with the required Holes for gas tube, Cut out for washbasin sink and other provisions as indicated in the drawings. The gaps around the SS sink and granite shall be sealed using sealant as specified. The edges all around the granite shall be bull nosed as indicated in the drawing.

#### **Granite Urinal Partition:**

Granite/Marble urinal partition refers to providing and installation of approved pre polished granite slab for urinal partition.

#### **Materials:**

Same as described in the section for Granite flooring works.

#### **Laying / Fixing:**

The partition shall be fixed of size and shape as indicated in the drawings. The Granite shall be fixed / anchored into a groove cut in the masonry wall. Grooves of depth 40mm or as required shall be cut along the wall and the Granite sunk into the groove and the grooves grouted using CM (1:3). The surface shall be raked and finished using white cement.

The partition shall be of the size and shape as indicated in the drawings / BOQ. The edges around the granite shall be bull nosed as shown in the drawings.

### **03.00 PLASTERING**

## Scope

This specification refers to the supplying and providing of plastering on wall surfaces of Concrete, brick, solid/hollow block masonry etc., curing, testing, protecting, maintaining, and completing in all respects as stated below. Plastering, as herein specified, shall be applied to all surfaces requiring painting or finishes as specified throughout the interior and exterior of the buildings as called for.

## Materials

### Cement

Refer general specification

### Fine Aggregates

Refer general specification

### Water

Refer general specification

### Neeru

Neeru shall be prepared out of class 'C' lime (i.e. pure fat lime) as mentioned in IS 712. All impurities, ashes or improperly burnt pieces shall be screened or picked out before slaking. The lime shall be slaked not less than one week and not more than 2 weeks before use. Lime shall be slaked and mixed with sufficient water to form a thick paste. It shall be reduced to a fine paste by grinding. The neeru shall be kept moist until use and no more than can be consumed in 10 days shall be prepared at a time.

Alternatively, readily available neeru shall also be used with the prior approval of the engineer.

### GI Mesh

Galvanized mesh (24 gauge, 12 mm size) and of size 4" x 10" or as instructed by Engineer to be used for plastering junction of dissimilar surfaces like RCC column and Block masonry, RCC beam and block masonry etc. the mesh shall be approved by Engineer before procurement and usage.

## Surface Preparation

All joints in the face work that has to be plastered shall be raked out to a depth equal to not less than the width of the joints or as directed by the Engineer. In new work the raking out shall be done when the mortar in the joints is still green. Smooth surfaces of concrete, old plaster etc. must be suitably roughened to provide necessary bond for the plaster. Any unavoidable projection in masonry / concrete surfaces shall be chiseled back. Care shall be taken that surrounding surfaces are not damaged and reinforcement is not exposed. The RCC surface to be plastered shall be hacked to ensure proper bonding of cement mortar to RCC surface. All dirt, soot, oil, paint or any other material that might interfere with satisfactory bond shall be removed.

In the case of stone masonry, bushing on the walls to receive the plaster shall not be more

than 12mm. The surface to be plastered shall be cleaned and scrubbed with fresh water and kept wet for 6 hours prior to plastering. It shall be kept damp during the progress of the work. The plastering shall not be commenced unless the Engineer clears the preparatory work in writing. All chasings, installations of conduits, inserts, boxes, etc. shall be completed and finished with cement mortar with galvanized chicken mesh before any plastering or other wall finish is commenced on a surface. Galvanized chicken mesh (24 gauge, 12 mm size) shall be provided at junctions of brick masonry and concrete members

and other junctions, 150 mm on either sides of the junction in double fold or as called for, properly stretched and nailed, ensuring equal thickness of plaster on both sides of the mesh.

#### **Construction details**

The wall shall be dampened evenly and not soaked before application of plaster. Cement Mortar of specified proportion shall be prepared by mixing cement and sand using mechanical mixer or by using hand mixture, depending on the nature of work and as per Engineers Instructions. Cement mortar shall be used within half an hour from the time water is added to cement. Water shall be added gradually and the wet mixing continued for at least 3 minutes. A homogeneous mix of uniform colour shall be prepared as per IS: 2250 and use of excess water shall not be allowed.

Patches of plaster 15cm x 15cm shall be put on about 3m apart as gauges to ensure even plastering in one plane. In all plaster work, mortar shall be firmly applied with some what more than the required thickness and spread evenly well pressed in to the joint and on the surface and rubbed, leveled and smoothed with straight edge, wooden float and trowel to the required thickness and finished as approved by the Engineer to give a smooth true and even surface in plumb. Corners shall be finished to their true angles or rounded as directed by the Engineer. The mortar shall adhere to the masonry surface intimately when set and there should be no hollows when struck. Plastering of cornices, decorative features etc. shall be completed before the finishing coat is applied.

Alternatively, the plastered surface can be finished with sponge so as to expose the sand particles. Moistening shall be commenced as soon as the plaster has hardened sufficiently and is not susceptible to injury. Soaking of wall shall be avoided and only as much water as can be readily absorbed shall be used.

All plasterwork shall be kept damp continuously for period of 10 days. To prevent excessive evaporation on the sunny or windward side of the buildings, in hot, dry weather, matting or gunny bags may be hung over on the out side of the plaster in the beginning and kept moist. Should the mortar or for any other default and if the work is not done as specified above, the plaster shall be removed and redone at the contractor's expense.

Drip course wherever indicated in the drawings shall be provided at the time of plastering to prevent traveling of water drops from the projections. Thickness of plaster shall be as specified in the drawing/BOQ.

#### **Plastering with Neeru finish**

Plastering with neeru finish refers to the plastering that shall be finished with a neeru paste on the top.

#### **Construction details**

All the construction procedure is the same as described in 03.02.02, except that neeru shall be applied. Neeru shall be applied, to the prepared and partially set surface and polished to obtain a perfectly smooth surface and worked in.

#### **Rough Cast Plaster / External Plaster / Water Proof Plaster**

Roughcast (with or with-out colour) plastering shall consist of providing such plastering on the surface of concrete, brick, solid/hollow block masonry etc. to the requirements as stated below.

#### **Materials**

The first coat of plaster shall be of cement mortar of specified thickness and proportion as given in the drawings/ BOQ mixed and applied according to the relevant provisions of IS: 1661. The second coat shall be the roughcast mixture consisting of aggregate, which may vary in size from 5mm to 8mm and may consist of specially graded mixture mixed with fine sand and cement. The proportion of cement to sand to aggregate shall be as given in the drawing/ BOQ or as directed by the Engineer. In the case of coloured finish a high-grade mineral pigment of approved shade and brand shall be mixed with white cement while preparing mortar for the finishing coat.

#### **Construction details**

The surface shall be prepared as specified in the above section.

The finished thickness of the base coat shall be 12mm or as given in the BOQ/drawing. The thickness of the first coat shall be just sufficient to fill up all unevenness in the surface under treatment. The plaster shall be laid by throwing the mortar by using a strong whipping action and pressing to form a good bond. The surface shall be roughened.

The second coat must be applied while the first coat is still soft and plastic. The work shall generally conform to requirements IS:1661. it shall be ensured that the base surface which is to receive rough cast mixture is in plastic state. The roughcast mixture shall consist of sand or gravel or crushed stone of uniform colour from 2.36mm to 12.5mm or as specified and in the proportions as specified accurately to the effect required. The mixture shall be wetted and shall be dashed on the plaster base in plastic state by hand scoop so that the mix gets well pitched into the plaster base. The mix shall again be dashed over the vacant spaces if any so that the surface represents homogeneous surfaces of sand mixed with gravel. The standard of workmanship shall be at the very best quality and the whole of plastering is to be carried out in the best possible manner to the entire satisfaction of the Engineer.

Where specified, rectangular grooves 12 to 20mm wide and 8 to 10mm deep or as given in the drawing/ BOQ or as directed by the Engineer shall be provided in external plaster by means of timber battens or metal strips, fixed on plaster when plaster is still green. Battens or strips shall be carefully removed after initial set of plaster and broken edges

and corners made good. All grooves shall be uniform in width and depth and shall be truly in plumb and correctly aligned.

Drip course wherever indicated in the drawings shall be provided at the time of plastering to prevent traveling of water drops from the projections. Thickness of plaster shall be as specified in the drawing/ BOQ.

### **Pebble-dash finish**

Pebble-dash finish plaster shall consists of providing such plastering on the surface of concrete, brick, hollow block etc. to the requirements as stated below.

The joints shall be raked out, dust and loose mortar, shall be brushed out. The surface shall be thoroughly washed with water, cleaned and kept wet before plastering is commenced. Mortar of specified mix using the type of sand described in the item shall be used, where coarse sand is to be used, the fineness modulus of the sand shall not be less than 2.5 mm. The plaster base over which roughcast finish is to be applied shall consist of two coats, under layer 12mm thick and top layer 10mm.

Plastering shall be started from the top and worked down towards the floor. To ensure even thickness and a true surface, plaster about 15 x 15 cm shall be first applied, horizontally and vertically, at not more than 2 metres intervals over the entire surface to serve as gauges. The mortar shall then be laid on the wall, between the gauges with trowel. During this process, a solution of lime putty shall be applied on the surface to make the later workable.

The top layer shall be applied a day or two after the under layer has taken initial set. The latter shall not be allowed to dry out, before the top layer is laid on. The mortar used for applying top layer shall be sufficiently plastic and of rich mix 1:3 (1 cement: 3 fine sand) or as otherwise specified so that the mix of sand and gravel gets well pitched with the plaster surface.

In order to make the base plastic, about 10% of finely grouted hydrated lime by volume of cement, shall be added when preparing mortar for the top layer.

The washed pebble or crushed stone graded from 12.5mm to 6.3mm or as specified shall be dashed over the plaster base and the vacant spaces if any shall be filled in by pressing pebbles or crushed stone as specified by hand, so that the finished surface represents a homogeneous surface.

### **Pointing**

This specification refers to the furnishing of the material and providing pointing on the surface of concrete, brick, solid/hollow block masonry etc.

### **Construction details:**

#### **Surface preparation and racking:**

The joint shall be racked out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scraping. The surface shall then be



thoroughly washed with water, cleaned and kept wet before pointing is commenced. In case of concrete surface if a chemical retarders has been applied to the formwork, care should also been taken to see that the entire amount of retarders is removed, apart from cleaning and removing all dust particles. The joints shall be raked to such a depth that the minimum depth of the new mortar measured from either the sunk surface of the finished pointing or from the edge of the bricks shall not be less than 12mm. Mortar of specified mix shall be used.

**Application and finishing:**

The mortar shall be pressed into the raked out joints, with a pointing trowel, either flush, sunk or raked as per the design requirement. Care shall be taken that the mortar does not spread over the corner, edges or surface of the masonry. The pointing shall then be finished with proper tool, in the manner described below:

**Flush pointing**

Cement mortar shall be pressed into the joints and shall be finished off flush and level with the edges of the brick, tiles or stones so as to give a smooth appearance. The edges shall be neatly trimmed with a trowel and straight edge.

**Ruled pointing**

The joints shall be initially formed as for flush pointing and then while the mortar is still green, a groove of shape and size as shown in the drawing or as directed by the Engineer shall be formed by running a forming tool, straight along the centerline of the joints. This operation shall be continued till a smooth and hard surface is obtained. The vertical joints shall also be finished in a similar way. The vertical lines shall make true right angles at their junctions with the horizontal lines and shall not project beyond the same.

**Cut and weather struck pointing**

The mortar shall first be pressed in to the joints. The top of the horizontal joints shall then be neatly pressed back about 3mm or as directed, with the pointing tool so that the joints are pointing from top to bottom. The vertical joint shall be ruled pointed. The junctions of vertical joints with the horizontal joints shall be at true right angles.

**Raised and cut pointing**

Raised and cut pointing shall be adopted for stone masonry pointing. It shall project from the wall facing with its edges cut parallel so as to have a uniformly raised band of about 6 mm and width 10 mm or more as specified in the drawing/BOQ. The superfluous mortar shall be cut off from the edges of the lines and the surface of the masonry shall also be cleaned off all mortar. The finish shall be such that the pointing is to the exact size and shape required and the edges are straight, neat and clean. The pointed surface shall be kept wet for a period of 10 days.

**04.00 PAINTING**

The specification covers the various types of painting and finishing of all surfaces like masonry, concrete, plaster, structural and miscellaneous steelwork and all carpentry works as specified, throughout the interior and exterior of the building. The number of coats required in various situations and also the types of finish required for the several items of work such as cement based

paint, plastic emulsion paint, oil bound distemper etc., are specified in the schedule of works and specifications.

Before the commencement of the work the contractor shall provide sample panels of painting at his own cost for the approval of the Engineer to enable him to keep an accurate check on the materials supplied and final shade to be painted. It is however, the express responsibility of the contractor to provide any deviations and defects shall have to be rectified by the contractor at his own cost.

Contractor shall protect not only his own work at all times but also all the adjacent work and materials by suitable covering, protection or other methods acceptable to the Engineer during progress of painting. It is the responsibility of the contractor upon completion of painting work to remove all paint and varnish spots from floors, walls, glass panes and other surfaces and restore them to the original conditions. The work generally to be touched up shall be attended to after all other workmen have left. All accumulated material, rubbish etc., have to be cleared and the premises left in clean, orderly and acceptable conditions.

Contractor shall provide scaffolding wherever necessary erected on double supports tied together by horizontals, no ballies, bamboo or planks shall rest on or touch the surface which is being painted. Contractor is deemed to have considered the following while tendering and no extra claim on account of these will be entertained.

#### **Treatment to surfaces to be painted & other precautions**

- A. All the surfaces to be painted will be thoroughly cleaned. The surfaces shall be free from mortar droppings, oil, grease, efflorescence, mildew, loose paint or other foreign and loose materials. All loose scales and flakes shall be removed by rubbing with hessian cloth or sand papering or as specified. All holes shall be filled with CM1:3 and the surface rubbed smooth to get evenness with the existing surface.
- B. Storage of materials to be used on the job shall be only in a single place approved by the Engineer. Such storage place, shall not be located within any of the buildings included in the contract, unless permitted by the Engineer.
- C. Surfaces with mildew or efflorescence shall be treated as below:
  - (a) Mildew: All mildewed surfaces, shall be treated with an approved fungicide such as ammonia wash consisting of 7 gm. of copper carbonate dissolved in 80 ml liquor and diluted to 1 liter with water or 2.5 percent magnesium silica fluoride solution and allowed to dry thoroughly before paint is applied.
  - (b) Efflorescence: All efflorescence shall be removed by scrubbing the affected surface with a solution of mariatic acid in water (1: 6 to 1: 8) and then washed fully with clear water and allowed to dry thoroughly.
- D. Before painting, the contractor shall remove hardware, accessories, plates and similar items or provide ample protection to all such items. Upon completion of each space, the

contractor shall replace all fixtures removed. He shall remove doors if necessary to paint bottom edge. Only skilled mechanics shall be employed for the removal and replacement of above items.

- E. The method of application shall be as recommended by the manufacturer. Work shall be carried out by skilled workmen using proper tools, brushes, roller or sprayers as specified in the BOQ. Wherever the scaffolding is used, contractor will make sure that it is independent of the surface to be painted to avoid shade differences of the freshly repaired anchor holes. All coats shall be of proper consistency such that no brush marks are visible.
- F. Paint shall be applied only on a moisture free area. The number of coats shall be indicated as given in BOQ. All coats shall be thoroughly dry before being sand papered or before the succeeding coat is applied. The painting shall be done evenly and smoothly by means of crossing and laying off to ensure no brush mark are seen. Application of paint shall be as per the manufacturer's instructions.
- G. The wood surface to be finished shall be made free from protruding timber fiber, holes and shall be filled with teakwood batten. Putty shall be used to cover up the nail marks. G/80 sand paper followed by G/120 or G/150 sand paper shall be used to do the sanding of the surface. Sanding should be taken up only when it can be followed immediately by painting.
- H. All primers and under coats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as approved samples and all finish shall be uniform in colour and texture. All parts of moldings and ornaments shall be left clean and true to finish.
- I. Filling carpentry work should be done when the primer is just dry. For deep scratches, holes etc. stopping shall be done with putty of plastic wood (IS 423). Putty can be white lead with linseed oil base or synthetic metal putty. For all minor scratches and rough surfaces, like flush door's faces filling made out of one part of white lead, two parts of whiting (powdered chalk) mixed and kneaded in double boiled linseed oil shall be evenly applied and rubbed down with G/220 or G/240 sand paper after allowing it to dry overnight.
- J. All painted surfaces shall be uniform and pleasing in appearance. The colour, texture etc. shall match exactly with approved samples. All stains, splashes and, splatters of paint shall be removed from surrounding surfaces.
- K. Contractor shall not only protect his own work but also provide and use sufficient number of drop clothes, covers, tarpaulins and other screens to protect work done by other agencies and after finishing his work, remove all splatter and stains from such surfaces.

## Material

Paints, oils, varnishes etc. of approved brand and manufacture shall be used. Materials must be delivered to the job site in the original containers with the seals unbroken and labels intact. Each container shall give the manufacturers name, type of paint, colour of paint and instructions for reducing. Thinning shall be done only in accordance with directions. All rejected materials shall be removed immediately from the premises. All materials shall be subject to inspection and approval by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible and paint of one shade be obtained from the same manufacturing batch. All paints shall be subjected to analysis from random samples taken at site from the painters bucket, if so desired by the Engineer.

The paint shall generally conform to the chemical composition and other characteristics laid down in the relevant Indian Standard specification.

Paint shall be ready mixed and of 1st quality of the approved brand and manufacture. Mixing of paint by the contractor at site will not be allowed, except with preparation of ingredients and their quality shall be strictly maintained as per manufacturer's instructions and all as directed by the Engineer. All the materials shall be kept properly protected when not actually in use. Lids of containers shall be kept closed. Materials which have become stale or flat (in the opinion of the Engineer) to be removed from site forthwith.

Wherever the works 'approved' occurs in these specifications it shall mean that the competent authority for such approval is the Engineer. Any materials found not conforming to the relevant specification shall have to be removed by the contractor from the site at his own expenses.

### **Workmanship**

The type of paint and allied materials to be used, the number of coats to be applied, the preparatory treatment to be adopted shall be as indicated.

1. Where more than one coat is indicated, each coat shall vary slightly in shade. Undercoat being lighter than subsequent coat and shall be approved in writing by Project Manager before the next coat is applied.
2. No painting work shall be carried out in wet and very humid weather when there is danger of dew or whether is otherwise unfavorable. No painting or any other process likely to be damaged by dust shall be carried out in windy weather.
3. Painting except the priming coat shall be taken in hand after all other builder's work is practically finished.
4. The paint in the drum shall be thoroughly mixed prior to application.
5. The materials shall be mixed prepared and applied strictly in accordance with the instructions or recommendations of the manufacturers except where otherwise directed by the project managers. The paint shall be mixed periodically during brushing.

### **Storage of paints**

All containers of paints, thinners and allied materials shall preferably be stored in well ventilated room free from excessive heat, sparks or flame or direct rays of sun. The containers of paint shall be kept covered or properly fitted with lid and shall be kept open except while using. Materials, which become stale or fat due to improper and long storage shall not be used or mixed with usable stuff.

### **Compatibility of paints**

Before considering the application of undercoats and finishing coats, it shall be made sure that those selected are compatible with each other. If a non-elastic finishing coat is applied over an elastic primer coat, it may lead to cracking or ‘alligatoring’ of the finishing coat and the primary coat may become visible through cracks in the finishing coat. Similarly if the under coat contains a strong solvent, it may attack the primer coat and lead to shriveling (wrinkling) of the entire paint structure. As a general rule, it is safer to use primer, filler, undercoating and finishing paints made by the same manufacture.

### **Addition of Thinners**

Thinners (such as mineral turpentine) shall not be added to paints in the feeling that the consistency of the paint supplied by the manufacturer is too thick if the paint has been manufactured to conform to the specifications, the paint shall have the correct consistency and shall not require further dilution. If there is any doubt, the viscosity of the paint may be checked. If a slight adjustment of viscosity is necessary, thinner, recommended by the manufacturer shall be used after prior approval of project manager.

The surface must be thoroughly dry and clean before painting work is proceeded with at all stages or processes of work. All dust, dirt, rust and grease shall be removed before painting is started, painting shall follow immediately after pre-cleaning or pre-treatments of any contamination, which may occur in the intervening period, shall be removed.

### **Synthetic enamel paint**

Synthetic Enamel Painting refers to supplying and applying of painting the metal and other surfaces to the requirements as given below.

#### **Material**

Ready mixed oil paint, synthetic enamel paint, Aluminium paint, etc. as specified shall be used for painting. It shall be made from synthetic resins and drying oil with rutile titanium dioxide and other selected pigments to withstand rugged conditions, sunlight and dust. It shall be used for finishing the surfaces as specified in the schedule of quantities. The enamel paint shall confirm to IS: 2932.

#### **Application**

The metal surface to be painted shall be thoroughly cleaned, free from grease, patches, blisters, mortar or any other foreign material. If required, it shall be rubbed with emery cloth.

Corroded crust of any rusted area shall be removed using steel brush. The surface thus finished shall be approved by the Engineer before painting.

Mild rubbing with abrasive paper / hand scrapping to the full satisfaction of the Engineer. Clearing with solvents / scraping shall be limited to the affected areas only. All galvanized iron surfaces shall be pretreated with a compatible primer according to the manufacturers direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat. Before starting the work, the Contractor shall obtain the approval of the Engineer regarding the soundness and readiness of the surface to be painted on.

One shop coat of red oxide or zinc chromate primer or as specified shall be given to all iron surfaces. Painting work on steel and iron surface shall conform to IS: 1477 (Part I and II).

Initial coat of primer shall be applied on the cleaned surface. Then a coat of specified quality paint shall be applied evenly and smoothly.

The dried paint shall be rubbed down with sand paper and cleaned of dust. Only after that, the next coat of paint shall be applied. Number of coats shall be as specified in the BOQ. If the finish of the surface is not uniform additional coats as required by the engineer shall be applied to get good and uniform finish.

### **Waterproof Cement paint**

Waterproof Cement paint refers to supplying and applying of painting to the exterior surfaces to the requirements as given below.

#### **Material**

Cement paint of approved make shall be used. This shall be made from best quality white cement and lime resistant colours with accelerators, water proofing agents and fungicides. The paint shall confirm to IS: 5401.

#### **Application**

Surface to be cement painted shall be prepared as described above in section. The cement paint shall be prepared as per the specifications of the manufacturer. First coat of the paint shall be thoroughly applied on the surface by brush to form a good film appearance. Twenty-four hours after the application of the first coat, saturate the surface with water. The next coat shall be applied when the surface is still damp. The surface shall be rewatered after 24 hours to ensure that the cement paint has set well.

### **Acrylic Emulsion Paints**

Acrylic emulsion paint refers to supplying and applying of such paints on the surfaces of walls to the requirements as stated below.

### **Material**

The acrylic emulsion shall be made with best acrylic copolymers. The Engineer shall approve the shades for the walls paint. The paint shall be water based acrylic copolymer emulsion with rutile titanium dioxide and other selected pigment and fungicide. It shall adhere properly to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering the paint. After it is dried, it should be possible to washing with mild soap and water without any deterioration in colour or without showing flaking, blistering or peeling.

### **Application**

- A. Surface to be painted shall be prepared as described above in section. For the New work the surface shall be allowed to dry for atleast 48 Hrs after the preparation of the surface. The paint shall be prepared as per the specifications of the manufacturer.
- B. A primer coat shall be applied on the walls. After 24 hours of drying of primer coat specified approved quality paint shall be applied evenly and smoothly. If required filler putty coating may be given to give smooth finish before the painting begins.
- C. Painting shall be strictly as per manufacturer's specification. Each coat shall be allowed to dry out thoroughly and then lightly rubbed down with sand paper and cleaned of dust before the next coat is applied. Number of coats shall be as specified in the drawing/BOQ and if however the finish of the surface is not uniform additional coats as required shall be applied to get good and uniform finish at no extra cost. The final paint finish will be free from hair marks, brush marks or clogging of paint puddles in the corners of panel angles or mouldings. The final coat shall be applied with a roller, stippling brush or spray as directed by the engineer.

### **Dry Distemper**

Dry distemper refers to supplying and applying of such paint on the surface of walls with the requirements as stated below.

### **Material**

Dry distemper shall conform to IS 427 and shall be of approved make. Necessary primer (cement or self primer) shall be used as directed by the Engineer-in-charge.

### **Application**

- A. Surface to be painted shall be prepared as described above in section. The paint shall be prepared as per the specifications of the manufacturer.
- B. Area to be distempered shall be applied with one coat of white chalk solution mixed with required quantity of glue or plaster of Paris and shall be sand papered before distempering
- C. Dry distemper can be applied only after the plastered surface has dried for 2 months. New lime or lime-plastered surface shall be washed with a solution of 1 part of vinegar to 12

parts water or 1: 50 sulphuric acid solution. After 24 hours the wall shall be thoroughly washed with clean water.

- D. For cement-plastered surface, the surface shall be washed with a solution of 100 gms of zinc sulphate to 1 liter of water and then allowed to dry.
- E. The distemper shall be applied as per manufacturers instruction. The distemper shall be applied by uniform strokes of brush, first applied horizontally and immediately crossed off perpendicularly. The final finish shall be applied with roller and the finished surface be free of brush marks.

### **Acrylic / Synthetic distemper**

Acrylic / Synthetic distemper refers to supplying and applying of such paint on the surface of walls with the requirements as stated below.

#### **Material**

Distemper of required colour and of approved brand and manufacturer shall be used. The primer where used shall be cement primer or distemper primer. These shall be of same manufacturer as that of distemper. Only sufficient quantity of distemper required for the days work shall be prepared. The distemper shall conform to IS: 428.

#### **Application**

The surface shall be made good as specified in above section. The newly plastered surface shall be allowed to dry for two months before the application of the paint. Putty shall be applied wherever required to smoothen the surface as per the directions of the engineer. The application of paint shall be as per manufacturers specifications. One coat of distemper (diluted using water or specified thinner) shall be applied by brush in horizontal strokes followed immediately by vertical ones. Number of coats shall be as specified in the BOQ. The final coat shall be applied with roller and the surface shall be even and uniformly smooth.

### **Lime White Wash**

Lime white washing refers to supplying and applying of such white washing on the wall and other surfaces to the requirements as stated below.

#### **Material**

Pure shell lime or fat lime, or a mixture of two as per IS: 712, shall be used for white wash. The samples of lime brought to the site in un-slaked form shall be approved by Engineer.

#### **Application**

- A. The surface shall be prepared as specified above in section. White wash shall be prepared from fat lime or shell lime slaked onsite mixed with just enough water to make a thick paste and allowed to remain for at least 7 days before use.



- B. Sufficient water shall be added to this paste and stirred through clean and coarse cloth. 4Kgs. of gum dissolved in hot water shall be added to each cubic meter of the lime used.
- C. Specified amount of Ultra marine blue shall be added to give required whiteness. The white wash shall be applied by using flat brushes or spray pumps. on surface prepared. The wash shall be applied with brush with alternate coats of horizontals and verticals. When a coat is being given it shall be ensured that the previous one has dried up completely.
- D. One coat of white wash shall consist of one stroke from top downward, another from bottom upward over the first. Paint shall be applied in a uniform manner to achieve the required finished surface. It should not come off when rubbed hard with hand.

#### **Lime Colour Wash**

Lime color wash refers to supplying and applying of the painting on the surfaces using lime colour wash as specified under IS: 712.

#### **Material**

Mineral colours of approved make shall be used. The lime added to the mix should have no effect on the mineral colours. A sample of the colour wash shall be approved by the Engineer-in-charge.

#### **Construction details – Same as for white wash**

#### **Chemical Resistant Paint**

Chemical resistant paint as per IS:157 of approved brand and manufacture shall be used. Primer coat to be used shall be as per manufacturers specifications.

#### **Fire Resistant Paint**

Fire resisting paint (silicate type) shall be as per IS: 162 and of approved brand and manufacture. Primer to be used shall be as per manufacturers specifications. Application of paint shall also be as per manufacturer's specifications.

#### **Oil Resistant Paint**

Oil resistant paint shall be as per IS: 161 and of approved brand and manufacturer. Application of paint and the primer shall be as per manufacturers specifications.

## **Colorless lacquer polish**

### **General**

Nitro cellulose lacquer polish of approved brand manufacture and finish shall be used.

### **Preparation of Surface**

The surface shall be cleaned and all unevenness shall be rubbed down smooth with suitable grade sand paper and well dusted. Knots if visible shall be made good as per the direction of the Engineer. Holes and indentation on the surface shall be stopped with glaziers putty. The surface then shall be given a coat of ready made ragging wood filler and allowed to dry for maximum 4 hours. The surface again shall be rubbed down perfectly smooth with suitable emery paper and wiped clean. Thereafter a finishing touch up with ragging wood filler is to be given and allowed to dry. To receive the polishing the surface is again rubbed down smooth.

### **Application**

Nitro cellulose sealer coat of approved manufacturer shall be applied strictly as per the manufacturers specification. The polish shall be applied with a sprayer at suitable pressure and viscosity as recommended by the manufacturer, and allowed to dry for 4 to 6 hour and rubbed down with suitable grade emery. The surface shall be again sprayed with 3 coats of NC lacquer (3 wet on wet coat). Finally, the surface shall be given wax polishing by using rubbing compound.

## **Melamine Polish**

Melamine polish refers to furnishing of the material and finishing the wood surface with melamine polish as specified.

### **Material**

Apcolite Natural Wood Finish or equivalent polish (glossy / matt) of approved premium quality shall be used.

### **Application**

- A. Preparation of surface shall be carried out as mentioned below.
- B. The surface shall be made free of knots, holes and indentation on the surface. Emery Paper No.180 or with a suitable grade sandpaper shall be used and further the surface shall be made free of dust.
- C. Apcolite wood filler or approved equivalent filler shall be used to fill the holes if any. After drying for 2-3 hours, sanding shall be done using Emery paper no. 240 or 280. Single coat of Apcolite Natural Wood Finish Clear Sealer shall be applied for better adhesion of the polish

to the surface, if specified.

- D. After drying overnight, smooth sand with emery paper. Now apply Apcolite Natural Wood Finish which is a two component system consisting of base and hardener. These should be mixed in the recommended ratio in a glass, plastic or enameled container.
- E. Allow the mixture to stand for,30 minutes and then apply by brushing or spraying using the recommended thinner for the required consistency. The mixture of base and hardener should be used within 8 hours.

### **French polishing**

French polish refers to furnishing of the material and finishing the wood surface with French polish as specified.

#### **Material**

French polish shall be an approved make conforming to IS: 348. French polish shall be prepared on site by dissolving 0.7 Kg of best shellac in 4.5 liters of methylated spirit without heating. Different colours shall be provided to the finish using pigments.

#### **Application**

- A. Preparation of surface shall be carried out as mentioned above. The surface shall be made free of knots, holes and indentation on the surface. Emery Paper No.180 or with a suitable grade sand paper shall be used and further the surface shall be made free of dust.
- B. Knots if visible shall be covered with a preparation of red lead and blue. Resinous or loose knots and gaps filled with seasoned timber pieces made level with reset of the surface otherwise the French polish will get absorbed and a good gloss will be difficult to obtain. Putty shall be used if necessary to fill up the gaps in the surface.
- C. A coat of filler made of 2.25 kg. of whiting in 1.5 liter of methylated spirit shall be applied on the surface. When it dries surface shall again be rubbed down perfectly smooth with sandpaper and wiped clean.
- D. Polish shall now be rubbed on the surface, using pad (A piece of clean cotton & wool put into shape), uniformly and completely over the entire surface. Another coat shall be applied in the similar way.

A pad of woolen cloth covered by a fine cloth shall be used to apply the polish. The pad shall be moistened with polish and rubbed hard on the surface on a series of overlapping circles applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil on the face of the pad may be added which shall facilitate

this operation. The surface shall be allowed to dry and the remaining coats applied the same way. To finish off the pad shall be covered with a fresh piece fine cloth, slightly dampened with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall present a uniform texture and high gloss.

## **Wax polish**

### **General**

Wax polish shall either be prepared on site or obtained readymade from market. Polish made on the site shall be prepared from a mixture of pure bees wax from paraffin or stearine adulterates, linseed oil, turpentine oil and varnish in the proportion of 2:1.5:1:5 by weight. Bees wax and boiled linseed oil shall be heated over a slow fire. When the wax is completely dissolved the mixture shall be cooled till it is just warm and turpentine oil and varnish added to it in the required proportion and the entire mixture is well stirred.

Surface shall be cleaned. All unevenness shall be rubbed down with sand paper and well dusted. Holes and indentation of surface shall be filled with putty made of whiting and linseed oil. Surface shall be given a coat / filler made of 2.25kgs of whiting in 1.5 liters of methylated spirit. When it dries, surface shall again be rubbed down perfectly smooth with sand paper and wiped clean.

### **Application of Bees Wax or Wax Polish**

The polish shall be applied evenly with a clean soft pad of cotton cloth in such a way that the surface is completely and fully covered. The surface is then rubbed continuously for half an hour. After well rubbing in one coat of wax polish, the work shall be covered with dust proof sheet (cloth for preventing dust falling on the work). Subsequent coat shall be applied after the surface is quite dry and shall be rubbed off with soft flannel until the surface has assumed a uniform gloss and is dry, showing no sign of sickness. The final polish depends largely on the amount of rubbing which shall be continuous and with uniform pressure, with frequent changes in the direction.

## **Varnishing**

Varnishing refers to the furnishing and providing of varnish to the wood surface to the requirements as stated below.

### **Material**

Varnish of approved make shall be used for finishing.

### **Application**

Surface shall be prepared as described above. Two coats of clean boiled linseed oil shall be applied at sufficient interval of time. After the linseed oil has dried two coats of varnish shall be applied at sufficient interval of time. If the surface fails to produce the required gloss an additional coat shall be applied without any extra cost.

The finished surface shall be protected from dust and other flying matter until it dries.

### **Spirit polishing**

Spirit polishing refers to the furnishing and providing of such polishing over wooden surface varnishing to the requirements as stated below.

#### **Material**

Polishing material shall be prepared by dissolving pure shellac, varying in shade from pale orange to lemon yellow, free from dirt and other materials, in methylated spirit at the rate of 0.15 kg shellac to 1 liter of spirit or as per the manufacturers instruction. Suitable pigment to achieve the required shade of polish shall be added as directed by the Engineer.

#### **Application**

1. The surface, cleaned of all dirt, etc., shall be rubbed down smooth with sand paper and well dusted. Knots if visible shall be covered with a preparation of red lead and glue. Holes and indentations on the surface shall be covered with glazier's putty.
2. The surface shall then be given a coat of wood filler made by mixing whiting (Ground chalk) in methylated spirit at the rate of 1.5 kg of whiting to one 1 liter of spirit. The surface shall be rubbed with fine sand paper and wiped clean.
3. Three or more coats of polish shall be applied over the above surface, to achieve a finish as approved by the Project Manager / Engineer. The polish shall be applied with a pad of woolen cloth covered by a fine cloth. The pad moistened with polish shall be rubbed hard on the wood surface in a series of overlapping movements in parallel directions, applying the material uniformly over the entire area to give an even finish. Subsequent coats shall be applied in a similar manner after the previous coat is allowed to dry.
4. The finishing shall be done with a fresh piece of clean fine cloth, damped with methylated spirit and applied by light rubbing. The finished surface shall have a uniform texture and high gloss.
5. The finished surface shall be protected from dust and other flying matter until it dries.

### **External Synthetic / Textured painting**

#### **General**

Specification refers to furnishing of materials and painting of plastered or unplastered surfaces with Synthetic / Textured paint of approved make.

#### **Preparing Surface**

The surfaces to be painted shall be cleaned and all holes, cracks, surface defects repaired with gypsum and allowed to set hard. All irregularities shall be made smooth by sand papering, grinding etc. The surface so prepared shall be completely free from dust before painting is commenced.

#### **Priming coat**

The preparation of the surface and the application of the priming coat shall be done as recommended by the manufacturer of the paint.

#### **Finishing coats**

Two coats of finishing coats of approved shade shall be applied over the priming coats. The instruction of the manufacturers shall be followed in applying the finishing coats of paints.

#### **Synthetic Plastic Finishes**

Renovo synthetic plaster finish or equivalent as approved by the Engineer / Architect to External faces wherever specified in the drawings shall be carried out by specialist agencies approved by the Architect. Preparation of surface, brushing, removal of dirt etc., shall be carried out as mentioned earlier the document.

#### **Bitumen Paint**

Surface should be well cured with water for at least 7 days before application of Bituminous coat wherever necessary or as directed by the Project Manager / Architect.

The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar drippings and grease shall be thoroughly removed before painting is commenced.

The work shall not be taken up during hailstorm or Dust storm

Ready mixed Bitumen paint (Confirming to IS 158) shall be of approved brand and manufacturer. It shall be black, lead free, acid, alkali, heat, water resistant.

Bitumen is applied by using brush in two coats. The second coat to be applied after a minimum period of 3 hours, after the application of the first coat.

No hair marks from the brush or clogging of paint puddles in the corners of the panels, angles of moldings shall be left on the work.

#### **Staining**

### **Spirit stains**

Spirit stains are solutions of spirit soluble dyes in industrial methylated spirit. They shall be applied quickly and skillfully to avoid patchy effects. If applied to damp wood the dyes in the stain are liable to be thrown out of solution and cause discoloration.

### **Oil stains**

Oil stains consist of solutions of oil soluble dyes in linseed oil or of insoluble semi – transparent pigments ground in linseed oil and thinned with turpentine or other solvent. Wax may be added to make the stain less penetrating if so directed by Project Manager. If applied to damp wood they are likely to develop a milky effect or bloom.

#### **Note:**

Oil stains do not take well on certain resinous or oily woods, such as teak. These woods are pre-treated with solvents to remove the greasy matter from the surface prior to oil staining or varnishing.

### **Preparation of surface for Staining**

Surface to be stained shall be scrupulously clean and free from greasy finger marks. It shall be prepared by careful smoothening with fine abrasive paper used in the direction of the grain; scratches across the grain are likely to become stained darker than the rest of the surface. Small cracks or nail holes may be stopped with plastic wood or other suitable, stopping, if spirit stain is to be used. The stopping shall be rubbed down with fine abrasive paper when hard and touched with a little thinned knotting before staining. Where oil stain is to be used stopping shall preferably be done after staining, using tinted putty or wood filler.

### **Sizing**

For sizing, where indicated or directed softwood shall be treated with hot weak size of thinned shellac varnish before staining to prevent undue absorption of stain, but an excess of size shall be avoided. To control the depth of colour, however diluted stain may be made to soak well in to the wood. Where size is used, the surface shall be allowed to dry thoroughly before staining. In general, flat surface shall be treated first and mouldings and edges the last.

### **Application of Stains**

Stains shall be applied by brushing and wiped. The stain shall be so thinned that it can be applied fairly liberally without overstaining. Care shall be taken, especially on absorbent soft woods, to stain evenly and without overlapping. Spirit stains; in particular require careful and quick application as they drive very quickly.

### **Finishing on Wood Based materials**

Plywood is similar to solid wood in its finishing characteristics

#### **Hard Board**

To prevent swelling under the influence of oil paint, a coat of plastic emulsion paint thinned with water or shellac varnish shall be applied as the first coat and when dry, rubbed down with fine grade abrasive paper and followed with required undercoating and finishing coats as for the solid wood.

#### **Particle Board**

The surface shall be filled with thin brushable filler and finished as for solid wood.

#### **Insulation Board**

Two thin coats of plastic emulsion paint or any other water based paints shall be applied after dusting off the surface and finished as for solid wood.

#### **Mock up**

The contractor should prepare a sample of 3m x 3m size painting of all types and colours of painting as mock up before starting the execution of the project. Mock up shall be carried out at the place identified by the Engineer / Architect and retained till such time as advised by the Engineer / Architect. It is to be noted, materials used for this work are confirming to the respective standards as mentioned in the document.

## **05.00 CLADDING WORKS**

### **Scope**

This specification refers to the general requirements for supplying, installing and finishing of various types of wall cladding works for internal & external wall surface incl. Dadoing work, all curing, testing, protecting, maintaining and completing all works as stated below.



## **Materials**

Same as specified in general specification and flooring works

## **Wall surface preparation**

The wall surface can be Reinforced / Plain concrete, solid / hollow block masonry, Brick Masonry, Size Stone Masonry etc. For all types of cladding works on concrete wall, masonry wall etc to receive the dadoing / cladding the wall shall be adequately roughened, joints raked, thoroughly cleaned of all dirt, grease, loose particle, caked mortar droppings, and laitance, if any by scrub. Where the concrete is hardened so much that roughening the surface by wire brush is not possible, the entire surface shall be roughened by chipping or hacking and the skin removed. The surface shall be thoroughly cleaned and moistened with water, before fixing of cladding material.

## **Setting Out:**

The Contractor shall set out and mark on the wall surface the tile / Granite layout based on the approved drawings. The layout should indicate all the lines, levels, offsets, spacers if any, fixtures on wall etc. The Joints to be true to line, continuous, without steps, truly horizontal, vertical and in alignment. Cut tiles/slabs to be kept to the minimum, as large as possible and in unobtrusive locations. Joints in walls and floors to be in alignment.

Where positions of movement joints are not specified they are to be agreed with the consultants.

## **Construction / Workmanship:**

### **Granite/Stone Cladding:**

Granite cladding refers to furnishing and providing such cladding on to wall and other surfaces to the requirements as stated below. The contractor shall submit to the Engineer, complete shop drawings of the method of fixing in detail showing all parts of work, dimensions, anchorage, mechanical fixing devices and the work shall be strictly carried out according to that in letter and spirit. The below is indicated as guidance for the contractor.

### **Wet Fixing:**

Granite/stone slab shall be machine cut to desired shape and size. Granite shall be fixed using Cement Mortar (1:3) wherever wet fixing has been indicated. After setting out the layout of cladding and identifying the joints, the fixing of granite shall proceed from bottom level. The first panel of granite shall be fixed in the corners to true line and level and it must be ensured that the row of granite is in the same plane and level. Once the alignment and fixing of granite has been completed the gap between the wall and granite shall be grouted using cement mortar. Only on setting of this grout can the cladding continue to the next level.

### **Dry Fixing:**

Granite/stone slab shall be machine cut to desired shape and size. These Slabs shall be secured to the structure with non-ferrous anchorage (Hilti/ any other approved make), stainless steel clamps and dowels or any other equivalent system as approved.

After setting out the layout of cladding and identifying the joints, the fixing of granite shall proceed from bottom level. The first panel of granite shall be fixed in the corners to true line and level and it must be ensured that the row of granite is in the same plane and level. Once the alignment and fixing of granite has been completed the gap between the wall and granite shall be grouted using cement mortar. Only on setting of this cement mortar grout can the cladding continue to the next level.

### **Wall tiling**

Wall tiling refers to the fixing and finishing of tiles such as ceramic, vitrified and other tiles to the surface of the wall to the requirements as given below.

### **Fixing details**

The surface to be fixed with tiles shall be applied with a coat of plaster of thickness not less than 12mm with cement mortar of 1:6 mix proportion or as specified in the drawing/BOQ. The plaster surface shall be true to plum, alignment, without undulations and finished rough.

After thorough curing of the above layer, another layer of cement mortar shall be applied to a thickness not less than 6mm and with the specified mix proportion as given in the drawing shall be applied to exact line, plumb and angle as required. Tiles shall be kept wet 2Hrs prior to the fixing. A back pack of cement paste shall be uniformly spread on the back of the tile and it shall be fixed to the plastered surface which is sufficiently hard so as not to flake away when the tiles are tamped with an wooden mallet to get all the tiles in the same line and plane as the adjoining tile. The tiles are to be laid with flush joint or with suitable gaps as directed by the Engineer.

Alternatively, the tiles can be fixed by tile adhesives directly over the plastered surface.

The surface of the tiles shall be checked for evenness and for defective workmanship. The tiles found to be defective or defectively fixed shall be replaced to the complete satisfaction of the engineer. Tile surface shall be kept wet for a period not less than 10 days.

### **Raking and cleaning**

After the tiles have set, joints shall be raked and cleaned off the cement slurry with coir brush or trowel to a depth of 2-3 mm and the tile joints shall be flush pointed with white cement mixed with “Roff rainbow Tile Mate” or approved equivalent to match the colour of tiles as per manufacturers specification. The surface shall be carefully wiped off before it sets. Care shall be taken to ensure that the finished surface is to proper levels without any profusion waviness or zigzag. Joints between tiles shall be uniform in straight levels and lines. After completion of the entire work or part of it, the surface shall be cleaned of all stains, cement etc., by washing with mild hydrochloric acid and clean water or any

other approved compound. The finished wall shall not sound hollow when tapped with a wooden mallet.

## **06.00 DOORS AND WINDOWS**

### **Scope**

This section covers the general requirement for Timber, steel and Aluminium doors, windows, ventilators, rolling shutters, etc including supply and installation of all related proprietary, iron mongery, fitting and fixtures.

### **Materials and samples**

All doors, door shutters, fittings, fixture etc. to be factory finished, supplied from an approved source and to match approved samples.

### **Timber Doors**

#### **Materials**

The timber used shall be of the type specified in the BOQ/ drawing and of best quality. All timber shall be natural growth and uniform in texture and shall be well seasoned as per IS 1141. The moisture content shall not exceed the limits as per IS: 287. It shall be free from large, loose dead or cluster of knots, injurious open shakes, rot, decay, discoloration and all other defects and shall conform to IS 883. Wooden doors, window and ventilators frames and shutters shall conform to the provisions in IS: 4021 – Part 1 & 2.

#### **Flush shutter**

Interior wood door shutters shall be 35 mm thick phenol formaldehyde synthetic resin thermo pressed flush shutters or as specified. The shutters shall conform to IS: 2202 (Part-I) and the make shall be one of the approved make. The solid core shall be of wood laminate prepared from battens of well-seasoned and treated good quality having straight grains. These battens shall be generally of 50cm length and 2.5cm width. These shall be properly glued and machine pressed together, with grains of each piece reversed from that of adjoining one and shall have the longitudinal joints, staggered. Alternatively, the core shall be of solid teak particleboard. Edges of the core shall be lipped internally with first class teak wood battens of 4 cm. minimum depth, glued and machine pressed along with the core.

The core surface shall then have veneers not less than 4mm thick, firmly glued on each face. The first layer of veneer shall be laid with its grains at right angles to those of the core. The other two with their grains parallel to those of the core. Commercial plywood used on facing shall conform to grade I of IS: 303. The face veneers shall be of good quality and durable teak Veneer of minimum 1mm thick and shall conform to grade I of IS: 1328. Thermosetting synthetic resin conforming to IS: 848 or moisture-proof plywood grade M.P.F.I. shall be used. The combined thickness of all the veneers shall not be less than 4mm on each side. All doors shall have external lipping all around 6 to 10 mm thick in addition to internal lipping.

Samples of flush doors, block boards, etc shall be submitted to the Engineer for his approval and all shutters etc. supplied for use shall be similar to the approved sample in all respects.

#### **Panelled shutters**

The materials for the frame and shutter shall be as shown in the drawing. Plywood panels shall be made of B.W.P grade conforming to IS: 303. Teak wood styles and rails with teak veneered particleboard bonded with phenol formaldehyde synthetic resin adhesive conforming to IS: 3097 shall be used.

The thickness of the panels shall be 15 mm for 25 mm shutters and 20 mm for shutters of larger thickness. The edges of the panels shall be tapered symmetrically on all the sides for insertion into the styles and rails.

Depth of rebate in frames for housing the shutters shall in all cases be 1.25cm and the rebate in shutters for closing, in double leaf shutter doors shall not be less than 2 cm.

The edges of styles and rails all round the panels shall be moulded, rounded or chamfered on both faces of the shutter as directed by the Engineer.

#### **General requirement for woodwork**

The woodwork shall be as per the details provided in the drawings. The joinery work shall be accurately set out, framed and finished in a proper workman like manner. No patchwork shall be allowed. Joints shall be simple, neat and strong. Putty shall not be used to cover any defects.

All portions of timber abutting against or embedded in masonry or concrete shall be treated against termites by giving a coat of an approved wood preservative. All the exposed faces of the joinery shall be thoroughly planned. Jointing shall be by means of mortice and tenon, dovetailed joints or as directed by the Engineer.

The whole of joinery to be finished to the dimensions and sizes indicated in the drawings are subject to a tolerance to 1.50 mm of each plane face, but no allowance shall be given to flush doors, shutters, ply and other manufactured board etc.

If after execution any shrinkage or bad workmanship is found, the Contractor shall forthwith replace the same all as directed by the Engineer.

Edges of the beams, joists, posts, frames etc. shall be rounded, moulded or chamfered as directed.

The Contractor shall be responsible to deliver all items at site of work. The Contractor will submit a programme of work in such a way that requirements for each floor commencing from ground floor is completed before the requirement of the next floor and arrange to have them fixed in position as the General Builders work progresses.

### **Doors, Windows and Ventilators**

These shall be in accordance with the drawing in every detail and all joinery work shall be finished in a workmanlike manner. The wood used for frames shall be of the variety and quality as specified in the drawing/BOQ and shall follow the requirements as stated above for wood works. Rebates and mouldings shall be provided as shown in the drawing.

Holdfasts shall be of size 400 mm x 40 mm x 6 mm M.S. flat bent to shape with fish tail and shall be fixed to frame with sufficient number of screws as directed and these shall be 3 in number on each side for doors & 2 nos. on each side for windows, unless otherwise indicated in the drawings. When door/window frames are to be fixed to RCC column or RCC wall, holdfasts shall be substituted by suitable arrangements such as anchor bolts, coach screws, rawl bolts/grip bolts etc. to secure frames to RCC column or RCC wall as directed by the Engineer. The frame shall be fixed only after getting the approval of the Engineer. The joiner shall perform all necessary mortising, tenoning, grooving, matching, tonguing, housing, rebating and all other works necessary for the proper construction of framing, lining etc. and for their support and fixing in the building.

Glued joints are to be used where provision need not be made for shrinkage or other movements in the connections and where sealed joints are required. All glued joints shall be cross-tongued or otherwise reinforced. All nails springs, etc. is to be punched and puttied.

The door, window and ventilators shall be erected true to line, level and plumb, and shall be upright, square and free from twists. The end of the two sides of the frame shall be adequately embedded into the flooring.

Louvers fixed to ventilators shall be of wood, glass, AC sheet, or any other material as specified in the drawing/BOQ. Louvers shall be fixed in grooves of minimum 1.25 mm depth, made in the frame the Venetian blades shall be sloped outside to an angle of 45 degrees or as shown in the drawings, these shall overlap each other by about half of their widths.

The iron mongery for doors, windows and ventilators shall be provided and fixed as shown in the drawing. Unless otherwise specified hinges shall be 6" long brass or iron oxidized of approved make & quality.

#### **Glass:**

Glass shall conform to IS: 2835 unless otherwise specified, the glass shall be sheet glass of approved make and quality and shall be free from air bubbles, waves and other defects. The thickness of the glass glazing shall be as indicated in the drawing/BOQ. Glass shall be clear glass, tinted glass, toughened, frosted, pinhead, or reeded, etc., as specified in the drawing/BOQ. Glazing shall be fixed with teakwood beading as per detailed drawings.

#### **Laminated Flush Doors:**

The laminated flush doors shall have the well seasoned first quality Sal wood door frames with the standard rebated frames fixed on to the walls using MS holdfasts on either side embedded in concrete 1:2:4. The frame shall be painted 2 coats of enamel paint over a coat of primer at all the lvls and supplying & fixing of Flush shutter 35 mm thk of greenply/archidply, with 1.5mm laminate Finish with grooves. The Hardwares shall be of Dorset/Hafele / any standard approved make.

**Painted Flush doors:**

Specification as above with enamel painting 2 coats over a coat of primer.

**Veneered Flush doors**

Specification as above with veneer on both sides instead of laminate

**Fire Resistance Doors**

The rating of the fire doors shall be as given in the drawing/BOQ and the quality shall be approved by TAC/CBRI and tested conformed to IS 3614. The door shall meet the requirements of Tariff Advisory Committee. The Contractor is to submit the test certificates and sample door and got approval before placing the order. The fire resistance doors, either wooden or steel shall be as per drawing / BOQ and shall be in accordance with IS 3614.

**MS Doors, Windows & Ventilators**

**Internal Doors**

Internal door frames where called for shall be of pressed mild steel sections as per IS: 4351 of the size and details as shown on drawings or other documents. The sections shall be pressed from 18 gauge mild steel sheet unless otherwise specified to the profile shown, by means of a mechanical press of adequate capacity. The pressed section shall be true to profile and also true to dimensions called for. The frame members shall be of one piece and the corners of the frames shall be mitred, electrically welded and ground smooth. Mechanical joint tings of members may be accepted subject to approval by the Architect. Base ties of mild steel angles shall be provided for all door frames to retain the size and shapes of the frames during transportation, handling, storage at site and erection. Necessary provisions shall be made in the frames for fixing silencers, tower bolts, door closers and other hardware. Slots for receiving lock and latch shall be shop punched and not made at site. The size and the location of the slots shall match the type of lock specified and at the height shown on the drawings/ documents, hinges of specified type, make and size shall be fixed to the frames in the fabrication shop. The hinges shall be so fixed that the hinge flap is flush with the face of the frame. A reinforcing metal plate of 16 mm thickness with holes drilled and threaded to receive machine screws from the hinges shall be welded to the frames at hinge locations as shown on the drawings.

Holdfasts where called for shall be of mild steel flats of shapes and sizes as shown on the drawings/documents and shall be welded to frames. The frames shall be phosphated and

then given a coat of red oxide primer. The surfaces shall be as specified under 'PAINTING' as approved by the Architect.

### **Fittings**

Hinges, locks, tower bolts, rubber buffers, door closers and other fittings shall be fixed as called for in the schedule of Hardware.

### **Unloading and Stacking**

The fabricated frames shall be transported, bundled, unloaded and stacked in a careful manner. They shall be stacked on edge on level bearers and supported evenly. All precautions shall be taken to ensure that the frames are not damaged or distorted in any manner.

### **Fixing**

The door frames shall be fixed at the top & bottom through M.S. cleats as shown on the drawings. M.S. cleats of size and detail as shown or called for shall be anchored to the floor and roof slab concrete at the time of casting the concrete. The frame shall be securely fixed to the out-standing leg after erecting in true and correct position. When the frames are to be fixed to column/wall faces, they shall be fixed with rawl bolts/expansion bolts of approved make. The frames shall be fixed into position true to line and level using adequate number of expansion machine bolts (RAWL BOLTS) of approved size & manufactured in an approved manner. The holes in concrete/ masonry members for housing anchor bolts shall be drilled with an electric drill. The doors /windows assembled as shown on drawings/ documents shall be placed in correct final position in the openings and marks made on concrete members at jambs, sills, and heads against holes provided in the frames for anchoring. The frames shall then be removed from the openings and laid aside. Neat holes with parallel sides of appropriate size shall then be drilled in the concrete members to houses the expansion bolts. The expansion bolts shall then be inserted in the holes, struck with a light hammer till the nut is forced into anchor shell. The frames shall then be placed in final position in the openings and anchored to the supports through cadmiums plated machine screws of required size threaded to expansion bolts. The entire operation shall be subject to the approval of the Architect. The frames shall be set in the openings by using wooden wedges at supports and be plumbed in position. The wedges shall invariably be placed at the meeting points of glazing bars and frames. In the case of composite windows and doors the different units are to be assembled first. The assembled composite units should be checked for line and plumb before final fixing is done. The contractor shall be responsible for the doors & windows being set straight, plumb, level and for their satisfactory operation after fixing is complete. In case of brick wall, precast cement concrete (1:2:4 mix) blocks shall be provided at locations where the frames are to be anchored, at the time of building the wall. The rawl bolts shall then be anchored to these blocks.

Hollow of frames abutting concrete/masonry shall be filled with cement grout (1 cement: 3 coarse sand) densely packed and finished neat. All steel frames and other steel members shall be enamel painted as provided under "PAINTING" after the installation of the

shutters, glazing, etc.

### **Door Shutters**

Pivoted shutters shall have floor springs/ pivots of approved manufacturers at the bottom suitably fixed to the floor and pivots fixed at the top as shown in drawings or as called for in the specifications. The shutters shall be fabricated with M.S.light gauge roll formed sections conforming to IS specification including welding all the joints and panels made out of 18 gauge M.S. sheets cut to size and shape as shown in the drawings and fixed to the shutter frame by means of brass screws and cup washers as called for in the drawings. The contractor shall however get the shop drawings and the sample approved by the Architect before executing.

### **Fittings**

Fitting shall be of mild steel, brass, and aluminium. Some mild steel fittings may have components of cast iron. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. These shall be of the following type according to the material used. Samples and test certificates shall be provided by the contractor and prior approval obtained before using any of the fittings described below.

All fittings shall be made from one of the materials as described below or as specified in the drawing.

#### **Mild Steel Fittings**

These shall be bright satin finish black stone enameled or copper oxidized (black finish) nickel chromium plated or as specified in drawing.

#### **Brass Fittings**

These shall be finished bright satin finish or nickel chromium plated or copper oxidized or as specified in drawing.

#### **Aluminium Fittings**

These shall be anodized to natural matt finish or dyed anodic coating not less than the grade AC 10 of IS: 1868.

Screws for the fittings shall be made of the same material as that of the fittings. However chromium plated brass screws or stainless steel screws shall be used for fixing aluminium fittings. Fittings shall be fixed in the proper position as shown in the drawing and shall be truly horizontal or vertical as the case may be. Recesses shall be cut to the exact size and depth for the counter sunking of hinges.

### **Hinges**

#### **Butt hinges**



These shall be of the following type according to the material used

- Mild steel Butt hinges (medium)
- Cast brass butt hinges light/ordinary or heavy
- Extruded aluminium alloy butt hinges

#### **Mild steel (medium)**

These shall be of medium type manufactured from M.S. sheet. These shall be well made and shall be free from flaws and defects of all kinds. All hinges shall be cut clean and square and all sharp edges and corners shall be removed. These shall conform to IS: 1341.

#### **Hinge pin**

Hinge pin shall be made of mild steel wire. It shall be fit inside the knuckles firmly and riveted head shall be well formed so as not to allow any play or shake, and shall allow easy movement of the hinge, but shall not cause looseness.

#### **Knuckles**

The number of knuckles in the hinges of different sizes shall be as per IS: 1341. The size of knuckles shall be straight and at right angle to the flap. The movement of the hinges shall be free and easy and working shall not have any play or shake.

#### **Screw Holes**

The screw holes shall be clean and counter sunk. These shall be suitable for counter sunk head wood screws and of the specified size for different types, and sizes of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of the wood screws.

#### **Cast Brass**

These shall be light/ ordinary or heavy as specified in drawing. These shall be well made and shall be free from flaws and defects of all kinds. These shall be finished bright or chromium plated or oxidized or as specified in drawing. These shall generally conform to IS: 205.

#### **Hinge Pin**

Hinge pin shall be made of brass or of phosphor bronze. The hinge pins shall be firmly riveted and shall be properly finished. The movement of the hinge pin shall be free, easy and square and shall not have any play or shake.

#### **Knuckles**

The number of knuckles in each hinge shall not be less than five. The number of knuckles in case of sizes less than 40 mm shall be three. The sides of the knuckles shall be straight

and at right angle to the flap. The movement of the hinge pin shall be free and easy and working shall not have any play or shake.

### **Screw Holes**

The screw holes shall be clean and counter sunk and of the specified size for different types and size of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of wood screw specified.

### **Extruded Aluminium Alloy**

These shall be manufactured from extruded sections. These shall be well made and free from flaws and defects of all kinds. These shall generally conform to IS: 205.

### **Hinge Pin**

Hinge pin shall be made of mild steel (galvanized or aluminium alloy). The aluminium alloy hinge pin shall be anodized. The hinge pin shall be finally riveted and shall be properly finished. The movement of hinges shall be free easy and square and shall not have any play or shake.

### **Knuckles**

Number of knuckles in each hinge pin shall not be less than 5. The number of knuckles in case of sizes less than 40 mm be straight and at right angle to the flap. The movement of the hinge pin shall be free and easy and working shall not have any play or shake.

### **Screw Holes**

The screw holes shall be suitable for countersunk head wood screws, and of specified sizes for different type of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of wood screw specified.

### **Sampling and Criteria for Conformity**

The number of butt hinges to be selected from a lot shall depend on the size of lot and shall be in accordance with the Table given below. Butt hinges for testing shall be taken at random from at least 10 per cent of the package subject to a minimum of three, equal number of hinges being selected from each package. All butt hinges selected from the lot shall be checked for dimensional and tolerance requirements. Defects in manufacture and finish shall also be checked. A lot shall be considered conforming to the requirements of this specification if the number of effective hinges among those tested does not exceed the corresponding numbers given below.

Lot size	sample size	permissible no of defective hinges
Upto 200	15	0

201 to 300	20	1
301 to 500	30	2
501 to 800	40	2
801 and above	55	3

Note: Any hinge, which fails to satisfy the requirements of any one or more of the characteristics shall be considered as defective hinge and the entire lot rejected.

### Parliament Hinges

These shall be of mild steel cast brass or as specified in drawing, and shall generally conform to IS: 362. The size of Parliament hinges shall be taken as the width between open flanges. Mild steel parliamentary hinges shall be copper oxidized (thick finish) or as specified in drawing. The brass parliamentary hinges shall be finished bright, chromium plated or oxidized or as specified in drawing. The hinge pin shall be made of mild steel the case of brass hinges. The hinge pin shall be mild steel (galvanized) in the case of aluminium alloy hinges. The hinge pin shall be firmly riveted and shall be properly finished. The movement of the hinges shall be free, easy and square, and shall not have any play or shake. All screw holes shall be clean and counter sunk to suit the counter sunk head of wood screws specified. Sampling criteria shall be the same as described earlier for extruded aluminium alloy.

### Spring hinges (single or double acting)

These shall be single acting when the shutter is to open on one side only or double acting when the shutter opens on both sides. These shall made of M.S. or brass as specified in drawing, and shall generally conform to IS:453. Hinges shall work smoothly and shall hold the door shutter truly vertical in closed position. Each double-acting spring hinge shall withstand the following tests, which shall be carried out after fixing it to a swing door in the normal manner, as given below.

(1) When the door is pushed through 90° and released 2000 times on each side in quick succession the hinge shall show no sign of damage or any appreciable deterioration of the components during or on completion of the test.

(2) The door shall require a force of  $2.0 \pm 0.5$  kg for 100 mm hinges and  $3.0 \pm 0.5$  kg for 125 mm and 150 mm hinges at a distance of 4.5 cm from the hinge pin to move the door through 90°.

The size of spring hinge shall be taken as the length of the plate. These shall be of the following type.

(1) Mild Steel: The cylindrical casing shall be made either from M.S. sheet of 1.60 mm thickness, lap jointed and brazed, welded and riveted, or from solid drawn tube of thickness, pressed to form the two casing. It shall be stove enameled black or copper oxidized or as specified in drawing.

(2) Cast Brass: The cylindrical casing shall be made either from brass sheet of 1.60 mm thickness, lap jointed and brazed, or from solid drawn brass tube of not less than 1.60 mm

thickness. It shall be satin, bright nickel -plated or copper oxidized or as specified in drawing.

Sampling: The number of spring hinges shall be selected from the lot and this number shall depend on the size of the lot and shall be in accordance with the data given below.

Lot size no of samples		permissible No of defective ones
01 to 25	3	0
26 to 50	6	0
51 to 100	12	0
101 to 200	15	0
201 to 300	20	1
301 to 500	30	2
501 to 800	40	2
801 and above	50	3

#### **Rising Hinges**

These shall be made of brass, finished bright or chromium plated or oxidized or as specified in drawing. Its shape and pattern shall be as indicated in the drawing. The size of the rising hinge shall be taken as the length of its plate.

#### **Continuous Piano Hinges**

These shall be made from mild steel or aluminium alloy sheet, these shall generally conform to IS: 3818. All screw holes shall be clean and counter sunk. Piano hinges shall be fixed in the entire length of the cupboard shutters. Its size will be the width of the two flaps when open.

#### **M.S. Piano Hinges**

These shall be made from 1 mm or 0.80 mm thick M.S. sheets and shall be protected with anti-corrosive treatment such as bright polished chromium plated or oxidized finish. Hinge pin shall be of galvanized mild steel. It shall fit in the knuckle firmly so as not to allow any play or shake and shall allow easy movement of hinge, but shall not cause looseness. The sides of the knuckles shall be straight and at right angles to the flap. The movement of the hinge shall be free and easy and working shall not have any play and shake.

#### **Aluminium Piano Hinges**

These shall be made of aluminium alloy sheet and shall be anodized. The anodic coating shall not be less than the grade AC 15 of IS: 1868. Hinge pin shall be made of aluminium alloy with anodic coating not less than the grade of AC-15 of IS: 1868-1982. The hinge pin shall fit in the knuckle firmly so as not to allow any play or shake and shall allow easy movement of hinge but shall not cause looseness.

The sides of the knuckles shall be straight and at right angles to the flap. The movement of the hinge shall be free and easy and working shall not have any play and shake. Sampling and Criteria for conformity shall be same as specified in drawing for extruded aluminium alloy sections

### **Tee Hinges**

These shall be made from M.S. sheets and shall be either bright finished or stove enameled black or as specified in drawing: These shall generally conform to IS: 206 (Tee hinges shall be well made, free from burrs, flaws, and defects of any kind. The movement shall be square, and the working shall be free and easy without any play or shake. The hole for the hinge shall be central to the bore and shall be square. The hinge pin shall be firm and riveted over, so that the heads are well formed. All screw holes shall be clear and counter sunk and shall be suitable for the counter sunk head of wood screws. Sampling and Criteria for Conformity shall be same as specified in drawing for extruded aluminium sections.

### **Bolts**

#### **Sliding Door Bolts (Aldrops)**

These shall be of mild steel, cast brass, aluminium or as specified in drawing, and shall be capable of smooth sliding action.

#### **M.S. Sliding Door Bolts**

These shall be made of M.S. sheets and M.S. rods and shall generally conform to IS: 281. M.S. sliding door bolts shall be copper oxidized (black finish) or as specified in drawing.

#### **Cast Brass Sliding Door Bolts**

These shall be made from rolled brass and shall generally conform to IS: 2681. The hasp shall be of cast brass and secured to the bolt Alternatively, the hasp and the bolt may be cast in one piece. The fixing and staple bolts shall be cast with 6 mm studs. Bolts shall be finished to shape and have threaded ends and provided with round washers and nuts of square or hexagon type. All components shall be finished smooth and polished before assembly. Cast brass sliding bolts shall be finished bright or chromium plated or oxidized or as specified in drawing.

#### **Aluminium Sliding Door Bolts**

These shall be made of aluminium alloy and shall generally conform to IS: 2681. Aluminium sliding door bolts shall be anodized. All screw holes shall be counter sunk to suit the counter sunk head of screws of specified sizes. All edges and comers shall be finished smooth. In case of single leaf door, when iron socket plate or a brass or aluminium fixing bolts (or sliding door bolt) cannot be fixed, hole of suitable size shall be drilled in the door

frame and an iron or brass plate cut to shape shall be fixed at the face of the hole. The leading dimensions of the sliding door bolts are illustrated.

Sampling and Criteria for Conformity shall be same as specified in drawing for aluminium extruded alloy sections.

### **Tower Bolts**

These shall generally conform to IS: 204 (Part. I) & IS: 204 (Part. II). Tower bolts shall be well made and shall be free from defects. The bolts shall be finished to the correct shape and shall have a smooth action. All tower bolts made with sheet of 1.2 mm thickness and above shall have counter sunk screw holes to suit counter sunk head of wood screws. All sharp edges and comers shall be removed and finished smooth. The height of knob of tower bolt when the door, window etc. is in closed position from the floor level shall be not more than 1.9 meter.

Tower bolts shall be of the following types

(1) Aluminium barrel tower bolts with barrel and bolt of extruded sections of aluminium alloy. The knob shall be properly screwed to the bolt and riveted at the back.

(2) Brass tower bolts with cast brass barrel and rolled or cast brass bolt OR Brass tower bolts with barrel of extruded sections of brass and rolled or drawn brass bolt. The knobs of brass tower bolts shall be cast and the bolt fixed with knob, steel spring and ball shall be provided between the bolt and the barrel.

(3) Mild steel barrel tower bolts with mild steel barrel or mild steel bolt OR Mild steel tower bolts with mild steel barrel and cast iron bolts.

The plates and straps after assembly shall be firmly riveted or spot-welded. The rivet head shall be properly formed and the rivet back shall be flush with the plate. These shall be made in one piece.

Unless otherwise specified bolt shall have finish as given below:

Mild steel tower bolts (Types 1 and 2) Bolts bright finished or plated as specified in drawing and barrel and socket stove enameled black.

Brass tower bolts (type 3 to 5) Bolt and barrel polished or plated as specified in drawing.

Aluminium alloy tower bolts (type 6) Bolt and barrel anodized.

The anodic film may be either transparent or dyed as specified in drawing. The quality of anodized finish shall not be less than grade AC-10 of IS: 1868.

Sampling and Criteria for Conformity shall be same as specified in drawing for aluminium-extruded alloys (brass hinges)

### **Flush bolts**

These should generally conform to IS: 5187. These shall be of cast brass, cast aluminium alloy or extruded aluminium alloy as specified in drawing. Only one material shall be used in the manufacture of all the components of flush bolts except spring, which shall be of phosphor bronze or steel strip.

When the rod is completely in its maximum bolting position it shall be retained in that position by the spring. The length of the bolt shall be such that, when the bolt is pulled

down, the top of the bolt shall be flush with the top of the lip face. The top of the bolt shall be given a taper of 45° to enable easy pull or push.

Brass flush bolts shall be satin or bright polished. Alternatively they may be nickel or chromium plated as specified in drawing in 15:4827 or copper oxidized in accordance with 15:1378. Aluminium flush bolts shall be anodized and the quality of the anodized finish shall not be less than grade AC 15 of 15:1868.

#### Note

The working of flush bolts is found satisfactory only in case of shutters made of high quality timber like teakwood properly seasoned and when there is no warping due to changes in weather.

### **Locks and Mortice**

#### **M.S. locking bolt with holes for pad locks**

This shall conform to 15:7534. This shall be of mild steel polished bright or copper oxidized batch Electro-galvanized or stove enameled. In case of stove enameled locking bolts, the bolts may be finished bright.

#### **Pull Bolt Locks**

These shall be of M.S. cast brass aluminium as specified in drawing. M.S. pull bolt locks shall be copper oxidized (black finish) or as specified in drawing.

Brass pull bolt locks shall be finished bright, chromium plated or oxidized as specified in drawing. Aluminium pull bolt locks shall be anodized and the anodic coating shall not be less than grade. A.C.10 of IS: 1868. The bolt shall be 10 mm in diameter and the fixing plate 3 mm thick. The stop block shall be screwed to the fixing plate by a small ball and spring over which the bolt shall slide.

The fixing plate shall have four holes for fixing it to the door leaf, two of which shall be square to receive 6mm dia. bolts with round head the remaining two shall receive machine screw with lock nuts. The receiving plate shall be of the same width and thickness as the fixing plate and shall have 3 counter sunk holes.

Where the bolt slides into wooden members, like the chowkhat, which have a rebate, the receiving plate shall also be correspondingly shaped so as to fit into the rebate. The screws and bolts shall have the same finish as the main bolt. The leading dimensions of pull bolt locks are as given in the drawing. The denominating size of the pull blocks shall be length of the fixing plate between guides plus the thickness of the guides.

#### **Door Latch**

This shall be of mild steel, cast brass or as specified in drawing and shall be capable of smooth sliding action. In case of mild steel latch, it shall be copper oxidized (black finish) or as specified in drawing and in case of brass, it shall be finished bright, chromium plated or oxidized or as specified in drawing. The size of the door shall be taken as the length of the latch.

#### **Indicating Bolt (Vacant/Engaged)**

These shall be of cast brass finished bright chromium plated, oxidized or as specified in drawing. The Engineer shall approve the shape and pattern.

#### **Mortise Lock and Latch**

This should generally conform to IS: 2209. The length of the body towards the face shall denote the size of the mortice lock and it shall be 65 mm, 75 mm and 100 mm as specified in drawing. The measured length shall not vary more than 3 mm from the length specified.

#### **Non-interchangeable Keys**

Testing of non-interchangeable keys shall be as per IS: 2209. The clear depth of the body shall not be more than 15 mm. The fore end shall be firmly fitted to the body suitably by counter sunk head screw. The latch bolt shall be of specified material and of section not less than 12x16 mm for all sizes of locks. If made of two-piece construction both parts shall be riveted. Ordinary lever mechanism with not less than two levers shall be provided. False levers shall not be used. Lever shall be fitted with one spring of phosphor bronze or steel wire and shall withstand the tests as provided in IS: 2209. Locking bolts, spring and strike plate shall conform to IS: 2209.

**Handles:** These shall conform to IS: 4992.

**Keys:** Each lock shall be provided with two keys.

Sampling, criteria for conformity shall be the same as specified in drawing for extruded aluminium alloys (butt hinges)

Test certificates shall be provided by the manufacturer and prior approval obtained before using any of the fittings described below.

#### **Mortice Latch (with locking bolt)**

These are generally used in doors of bathrooms, WC's and private rooms. Mortice latch shall, in respect of shape, design and mechanism of the latch and its components parts, generally conform to IS: 5930. The material used for the different component parts of the latch shall comply with Tables 1 and 2 of IS: 5930, unless otherwise specified. The size of the latch shall be denoted by the length of the body towards the face and shall be 65 mm, 75 mm or 100 mm as specified in drawing. The depth of the body shall not be more than 15 mm. The latch shall be of size 10 x 18 mm of shape as shown in Fig. 1 of IS: 5930. The locking bolt shall be of section not less than 8x25 mm for all size of locks. The mechanism of the latch bolt, its spring, striking plate etc. shall be described in IS: 5930.

The handles provided should conform to IS: 4992.

Sampling, criteria for conformity shall be as per aluminium extruded sections (butt hinges).

#### **Mortice Lock and Latch (rebated)**

These are slightly different from mortice lock described earlier and are designed for use in double leaved doors. These should generally conform to IS: 6607. Handles, keys, sampling criteria for conformity and test shall be as specified in drawing in extruded aluminium alloys (butt hinges).

#### **Mortice Night Latch**

This is a mortice lock having a single spring bolt withdrawn from the outside by using the key and from inside by turning the knob and with an arrangement whereby the lock can be



prevented from being opened by its key from outside while the night latch is used from inside the room. This should generally conform to IS:3847.

It shall be cast or sheet brass, cast or sheet aluminium alloy or Mild steel as specified in drawing and of best quality of approved make. These shall be bright finished or copper oxidized (black) finish as specified in drawing. The length of the face shall denote nominal size of the latch over the body in millimeters. These shall have not less than two levers. False (Dummy) levers shall not be allowed.

#### **Keys**

Each latch shall be provided with two keys which should work smoothly and without any appreciable friction in the lock.

#### **Cupboard or Wardrobe Lock**

This should generally conform to IS: 729. The size of the cupboard lock shall be 40, 50, 65 & 75 mm. This shall be made of cast brass and shall be of the best make of approved quality. These shall be finished bright or chromium plated or oxidised or as specified in drawing. The size of the lock shall be denoted by the length of the face across the body in mm. These locks shall be fitted with four, five or six levers as specified in drawing. False (dummy) levers shall not be used.

#### **Handles**

These should generally conform to IS: 208. The door handles shall be well made and free from defects. These shall be finished correct to shape and dimensions. All edges and corners shall be removed and finished smooth so as to facilitate easy handling. Cast handle shall be free from casting defects. Where the grip portion of the handle is joined with the piece by mechanical means, the arrangement shall be such that the assembled handle shall have adequate strength comparable to that of integrally cast type handles. Door handles shall be of the following types according to the material used.

#### **Cast or Sheet Aluminium Alloy Handles**

These shall be of aluminium of specified size, and of shape and pattern as approved by the Engineer-in-Charge. The size of the handle shall be determined by the inside grip of the handle. Door handles shall be of 100 mm size and window handles of 75 mm size unless, otherwise specified. These shall be fixed with 25 mm long wood screws of designation No. 6. Aluminium handles, shall be anodised and the anodic coating shall not be less than grade AC 15 - IS: 1868 as specified in drawing. The finish can be bright Natural, matt or satin or dyed as specified in drawing.

#### **Cast Brass Handles**

These shall be of cast brass of specified size and of the shape and pattern as approved by the Engineer. The size of the handle shall be determined by the inside grip of the handle. Door handles shall be of 100 mm size and window handles of 75 mm size, unless otherwise specified. These shall be fixed with 25 mm long Wood screws of designation No 6. Brass handles shall be finished bright satin or nickel chromium plated or copper oxidised or as specified in the drawing.

#### **Mild Steel Handles**

These shall be of mild steel sheet, pressed into oval section. The size of the handles will be determined by the inside grip of the handle. Door handles shall be 10 mm size and window handles of 75 mm size unless otherwise specified. These shall be fixed with 25 mm long wood screws of designation No.6., Iron handles shall be copper oxidised (black finish) or stove enameled black or as specified in drawing.

Sampling and Criteria for conformity shall be as specified in drawing for extruded aluminium alloy-butt hinges.

## **Stoppers**

### **Floor Door Stopper**

The floor door stopper shall conform to IS: 1823. This shall be made of cast brass of overall size as specified in drawing and shall have rubber cushion. The shape and pattern of stopper shall be approved by the Engineer. It shall be of brass finished bright, chromium plated or oxidised or as specified in drawing. The size of floor stopper shall be determined by the length of its plate. It shall be well made and shall have four counter sunk holes for fixing the door stoppers to the floor by means of wood screws. The body or housing of the door stopper shall be cast in one piece and it shall be fixed to the cover plate by means of brass or mild steel screws and cover plate shall be of casting or of sheet metal. The spring shall be fixed firmly to the pin. Tongue which would be pressed while closing or opening of the door shall be connected to the lower part by means of copper pin- On the extreme end a rubber piece shall be attached to absorb shock. All parts of the door-stopper shall be of good workmanship and finish, burrs and sharp edges removed. It shall be free from surface and casting defects. Aluminium stopper shall be anodised and anodic film shall not be less than grade AC-10 of IS: 1868. Sampling and criteria for Conformity shall be same as specified in drawing extruded aluminium alloys-butt hinges.

### **Hanging rubber door stopper**

These shall be of cast brass, finished bright, chromium plated or as specified in drawing. Aluminium stopper shall be anodised and the anodic coating shall not be less than grade AC-10 of IS: 1868. The size and pattern of the doorstopper shall be approved by the Engineer-in-Charge. The size shall be determined by its length.

## **Doors and Closers**

### **Universal hydraulic door closer (Exposed Type)**

These shall be made of cast iron/ aluminium alloy /zinc alloy and of shape and pattern as approved by the Engineer-in-Charge. These shall generally conform to I.S Specifications for door closers (Hydraulically regulated) IS: 3564.

The door closers may be polished or painted and finished with lacquer to desired colour Aluminium alloy door closer shall be anodised and the anodic coating shall not be less than grade AC 15 of IS: 1868. All dents, burrs and sharp edges shall be removed from various components and they shall be pickled, scrubbed and rinsed to remove grease, rust, scale or any other foreign elements. After pickling, all the M.S. parts shall be given phosphating treatment in accordance with IS: 3618.

The nominal size of door closers in relation to the weight and the width of the door size to which it is intended to be fitted shall be given below.

Up to 35	700	For light doors such as double leaved and toilet doors
36 to 60	850	Interior doors, such as of bed rooms, kitchen and store
61 to 80	1000	Main doors in a building, such as entrance doors

#### **Sampling and Criteria for Conformity**

All the door closer of the same nominal size and shape and from the same batch of manufacture, in one consignment shall constitute a lot. The number of door closers to be taken at random from a lot shall depend upon the size of the lot. The sample shall be tested for construction, finish, dimensions, and inter-changeability of parts and performance.

Performance requirements: After being fitted in its position when the door is opened through 90°, the same should swing back to an angle of 20°±5° with nominal speed but thereafter, the speed should get automatically retarded and in case of doors with latches, it should be so regulated that in its final position the door smoothly negotiates with the latch.

#### **Miscellaneous Fittings**

##### **Hooks and Eyes**

These shall be mild steel or hard drawn brass or as specified in drawing. Mild steel hooks and eyes shall be copper oxidised (black finish) or as specified in drawing. Cast brass hook eyes shall be finished bright or chromium plated. These shall be well made and free from defects. They shall be finished to the correct shape and dimensions so as to function properly when they are in use. Cast hooks eyes and plates shall be free from casting and other defects. All these shall generally conform to IS: 207. All size of hooks and eyes shall be determined by the length of the hooks measured out to out. Unless otherwise specified the articles shall be finished bright.

##### **Casement Window Fasteners**

These shall be made of cast brass, finished bright, chromium plated or oxidised or nylon or as specified in drawing. Casement fasteners for single leaf window shutter shall be left or right handed as specified in drawing. These shall not weigh less than 0.20 kg per fastener. Nylon window fasteners shall conform to IS: 6318.

##### **Casement Brass Stays (Straight Peg Type)**

These shall be made of mild steel, cast brass, aluminium (extruded section) or plastic (Polypropylene) as specified in drawing. Mild steel casement stays shall be a copper oxidised (black finish) or as specified in drawing. Cast brass stays shall be finished bright or chromium plated or as specified in drawing. Aluminium stays shall be anodised and the anodic coating shall not be less than grade AC-10 of IS: 1868. Aluminium and M.S. stays shall be made from channel section. The stays shall not weigh less than that indicated below:

- 200 mm - 0.24 kg each
- 250 mm - 0.28 kg each
- 300 mm -0.33 kg each

The shape and pattern of the stays shall be approved by the Engineer-in-Charge. The size of stays shall be determined by its length as shown in the plate. The plastic (Polypropylene) stays shall conform to IS: 6318-1971.

#### **Fan light Pivots**

These shall generally conform to IS: 1837. These shall be of mild steel or cast brass or Aluminium or as specified in drawing. The brass, fan light pivots shall be finished bright, chromium plated or as specified in drawing. M.S. fan light pivot shall be copper oxidized (black finish) or as specified in drawing. The base and socket plate of M.S., fan light pivots shall be made from minimum 3.0 mm M.S. sheet and the pivot shall be of round M.S. bar of minimum 10 mm diameter projecting out by minimum 12 mm length and firmly riveted to the base plate. The base and socket plate of cast brass fan light pivots shall be made from minimum 3.0 mm thick brass plate and the projected pivot shall not be less than 12 mm diameter and 12 mm length, cast in single piece with the base plate.

#### **Fan light catch**

This shall conform to IS: 364. This shall be made of mild steel or cast brass or Aluminium or as specified in drawing. M.S. fan light catch shall be copper oxidised (black finish) or as specified in drawing. Brass catch shall be finished bright, chromium plated or oxidised or as specified in drawing.

#### **Chain with Hook for Ventilator**

This shall generally conform to IS: 3828. This shall be made of mild steel, hard drawn brass or cast brass welded or twisted or as specified in drawing. The brass chain shall be finished bright, chromium plated or oxidised or as specified in drawing. M.S. chain shall be copper oxidised (black finish) or as specified in drawing. One end of the chain shall be provided with an eye and the other end with a staple. The minimum thickness of plates shall be 3 min. The chain shall be 300 mm long made from minimum 4 mm hard drawn wire with properly jointed or twisted ends.

#### **Quadrant Stays**

These shall be made of cast brass and finished bright or chromium plated or as specified in drawing. The shape and pattern shall be approved by the Engineer-in- Charge. It shall not weigh less than 0.20 kg each.

#### **Hasp and Staple Safety Type**

This shall be made of mild steel, cast brass or aluminium as specified in drawing. This shall generally conform to IS: 363. M.S. Hasp and staples shall be finished black enameled, or copper oxidised (black finish) or as specified in drawing. Brass hasp and staples shall be finished bright chromium plated or oxidised or as specified in drawing. Aluminium hasp and staples shall be anodised and the anodic coating shall not be less than grade AC- 15 of IS: 1868.

M.S. hasp and staples shall be manufactured from M.S. sheet and brass hasp and staples by casting and Aluminium hasp and staples shall be made from dye section. The hinge pin, which in all cases shall be of mild steel, shall be firm and its riveted heads well formed. The movement of hasp shall be free, easy and square and shall not have any play or shake. The hasp shall fit, in the staple correctly. The staple except in the case of cast one, shall be

riveted properly to its plate. The ends of the hinge pin for the safety type hasp shall be riveted and properly finished. All screw holes shall be clean and counter sunk to suit counter sunk wood screw. All edges and corners shall be rounded.

#### **Ball Catches for Wooden Almirah**

This should generally conform to IS: 8756. These may be of brass sheets or cast brass with steel balls of sizes 6,7,5,9.5 or 12 mm dia as specified in drawing. The size shall be denoted by the external diameter of the cylinder holding the steel ball with spring. When the almirah is in the closed position it shall be retained in that position by the spring action of the ball catch and shall be so in continuous usage. The door shall open only when it is pulled open.

Sampling, criteria for conformity and test shall be as specified in drawing for extruded aluminium alloys.

#### **Finger Plate**

This shall be finished bright, chromium plated, oxidised of brass, or anodised aluminium or transparent plastic or as specified in drawing. This shall be made from brass or aluminium plate of 1.6 mm thickness with beveled or square edge as specified in drawing. The size of the plate shall be 300 x 65 mm unless otherwise specified. The shape and pattern shall be approved by the Engineer-in-Charge.

#### **Kicking Plates**

This shall be of brass (finished bright or chromium plated or oxidised) bronze, stainless steel, and aluminium or as specified in drawing. Aluminium kicking plates shall be anodised and the anodic coating shall not be less than grade AC-10 of IS: 1868, It shall be made from a plate of minimum thickness 3.0 mm & 1.5 mm in case of stainless steel. Shape of the plate shall be as specified in drawing. This shall have beveled or straight edges and shall be fixed by means of counter sunk or rounded screws of the same material and finished as that of the plate. The shape and pattern shall be according to the drawings or as approved by the Engineer.

### **7.00 ALUMINIUM DOORS & WINDOWS**

**Supply, Fabrication and Fixing of Aluminium Windows / Ventilators / Doors using aluminum extruded sections as per (IS 1948 : 1961 & IS1949:1961) Specification of HYDRO/SCHUCO/JINDAL / INDAL or any other approved make.**

**The Aluminum Windows / Ventilators / Doors**

The Windows could be fixed / sliding / Top Hung / Hinged as per the drawings and details indicated in the architects drawings. The sliding windows could be of two or three tracks with the provision for fixing the mosquito shutters. The shutters to be provided in such a way that the interlocking system to be proper. The bottom section to have proper draining arrangement to leave out the water.

All the aluminum sections should be anodized 12 to 15 microns thickness as per IS Specifications. Where powder coating is required the same shall be done as per IS 7088 to 60 Micron minimum Thickness

The sections to be fabricated by reputed firm by cutting to the required length, joints mitered subdividing the frame tenoned and riveted in the assembled frame to be stiffened with end clips, corner angles etc. fixed to the wall, lintel, floor-beam as the case may be with necessary steel screws, rawl plugs and teak wood guttas, etc complete all as per drawing/instructions of architects.

Painting the sections with a thick coat alkali resistant bituminous paint for faces coming into contact with masonry, concrete, plaster or any dissimilar materials.

Glazing Clips, EPDM Gaskets shall be used for sealing and weather strips Door shutter shall consist of concealed mortise locks of approved make, Concealed tower bolts, locking arrangements. The silicon sealant of approved make to be used wherever required for weather proofing. The windows and ventilators shall have approved fittings like handles, locking arrangements and peg stays.

Glazing to be with 4 mm clear plain glass where unsupported glazing area is 1.5 sqm and less and 5 mm clear plain glass where the unsupported glazing area is more than 1.5 Sqm. The glass to be without any flaws, bubbles, scratches etc.

The frames, glass, grills and the adjoining structures to be clean and tidy. The gaps between the frames and the plastered surface to be filled with approved quality mastic cement. Fixing with necessary TW plugs and cadmium plated brass screws and/or anchor fasteners/bolts as directed in masonry and/or concrete openings. Wherever required to break the flooring, RC Slab for fixing the frames, floor springs etc and making good the surface. The assembled frames should be stiffened with end clips, corner angles and fixed to the wall, lintel, beam, floor as the case may be with

necessary screws, rawl plugs and including cutting, masonry, concrete and making good to the original surfaces etc complete all as per drawing/instructions of architects.

The glass shutters shall be of Saint Gobain / Asahi / Modi or any other approved equivalent with standard accessories and fittings. All the Aluminium works should be as per the details of the Engineer. It shall be designed to accommodate thermal movement of the aluminium components resulting from the exterior skin temperature from 15° C to 82° C and interior temperature of 15° C to 30°C. All windows, ventilators and doors should be made with all necessary frame work and should be water-tight. Double glazed Sliding / Openable Windows, Ventilators, Double Swing Single / Double leaf Shutters for Doors with or without fan light, shall be made as indicated in the drawings.

All aluminium window, doors, window wall etc. are to form a system, custom designed for optimum performance. These windows, doors and window wall should exceed the performance standard requirements whereas the depth of the profile shall be determined by adequate structural calculation. Windows, in general will not produce any whistling noise due to wind forces and also will be free from rattling of the shutters. Adequate water drainage as well as pressure equalization methods will be adopted in the system design to avoid later penetration and air infiltration system guarantee of 10 years will be required.

Aesthetically the design of the window walling system is to provide a filtering envelope to a building and to give uniform appearance. The window walling system design shall be capable of accommodating dead loads and wind loads and other movements without reducing its performance or causing permanent damage. The Window walling system own dead loads and the loads occurring due to wind forces acting on them shall be transferred to the structure at its anchorage points.

The system design shall accommodate a standard temperature range of + 5°c to 100°c. The system design shall be capable of incorporating seismic joints, to deal with earthquakes. The window walling system shall allow the structure deflections shall also accommodate variable deflection limits.

The structural glazing system shall be proprietary as shown on detail drawings with possibility of re-glazing of vision panels from inside the building using sub shutter glass panel unlock systems. The whole system design parameter is to install the structural glazing system from the inside of the building.

All nuts and bolts are to be tightened to requisite torque using a torque spanner / calibrated electric screwdriver. All spandrel area will have GI metal sheet formed tray filled with Rockwool of 50mm thickness fastened by using dynastic fasteners. Necessary fire and smoke barriers to be incorporated at every slab by using Rocksl, fire protection slab material and fire retardant silicone.

The whole window walling system has to be designed on the rain screen principle with pressure equalization provisions. In order to facilitate thermal expansion, vertical mullions shall have expansion Joints at every second floor level. Structural design criteria will be based on basic wind speed data available as per IS375 with correction factors applicable.

All joints in the framework shall be crimped using adequate insert and corners shall be sealed with Terecon /3M adhesive metal corner sealant. All straight joints to have EPDM flap gaskets at the joint to avoid water leakage. All screws in the assembly and installation shall be fully concealed and made of Stainless steel.

Systems accessories are to be purpose designed, part of the system product and shall operate smoothly for the whole of the guarantee period. Side hung windows shall be properly closed & will lock at min. three points in the frame. They will also incorporate center gasket. All sliding window roller shall be ball bearing type with Teflon outer body shell.

Aluminium louvers - sections shall have extrusions as per the IS standard mentioned above. The louvers shall be with glass or aluminium and the same shall be as per the respective standards mentioned in the technical specification. The make of the glass shall be Saint Gobain / Modi / Asahi.

## **08.00 NON-STRUCTURAL METAL WORKS**

### **Scope:**

This section of specification covers the general requirements for non-structural steel works



including handrails, Staircase, Balcony /Terrace handrails, window grilles etc

### **Materials:**

#### **Steel**

Hot rolled steel sections such as angles, flats, square bars, plates, etc., shall conform to IS 226-1975 and IS 800-1984 Box sections in steel shall conform to IS 801-1975 code of practice for use of cold formed light gauge steels structure members in general building construction.

Stainless steel tubes and rods shall comply with AISI 304 or other grades as called for on the drawings. They shall be manufactured by CHOKSEY tubes, Bombay or any other manufacturer approved by the superintendent.

Stainless steel members shall have a uniform finish free from blemishes discoloration and other defects. Finish for stainless steel shall be polished with fine grit to dull polish no4, unless otherwise specified.

#### **Railings**

Stainless steel or other types of railing to be used on staircases and balconies as shown on the drawings shall be executed by craftsman, specially trained in the trade and in a shop fully equipped to carry out all phases of fabrication. All work to be done in accordance with the best-accepted practices and as called for on the drawings. All work shall be shop fabricated and brought on site for erection unless the superintendent has approved fabrication on site.

The railings shall be assembled square true to proper plan or curved to the radius called for on the drawings. Jointing methods shall be flush type that will produce an adequately strong joint for a particular application, and approved by the superintendent before jointing is done.

Welding shall be executed from the non-exposed side, as far as possible and in each case the welds shall be ground smooth and finished with a texture matching the parent metal. All welds shall be finished smooth and square.

The assembled railing shall be installed true to line and levels and anchored into slabs/ treads. Pockets shall be grouted with cement mortar / concrete mixed with non-shrink additive and finished properly. The finished railing shall be polished again after the installation is completed to the finish approved by the superintendent.

Stainless steel tubes and rods shall be by CHOKSEY tubes, Bombay or any other manufacturer approved by the superintendent. Wall thickness of tubes shall not be less than 2mm.

#### **Galvanized Bracket Supports / Rungs**

Supports to sloping chajjas and washbasin counters and rungs used as ladders shall be of mild steel box sections or Solid sections of size as shown on the drawings. They shall be galvanized after fabrication.

#### **Rolling Shutters and Collapsible Steel doors**

### **Rolling shutters**

These shall be constructed with Square / curved slats from steel metal 18 S.W.G. with dimensions of 62 mm between centers or interlock & bridge depth of 10 mm. These slats shall slide into one another forming a continuous hinge throughout their length & shall be fitted with alternating & lock. They shall coil at the head of the opening, with the weight of shutter at all positions counter balanced by springs. Guides shall be 62 mm unless otherwise specified. The springs shall be best quality tempered steel. The shutter when coiled up shall be housed in a box of 18 gauge sheet metal. They shall be opened from the outside and locking arrangement (both inside and outside), metal box, etc.

### **Collapsible Steel Doors**

These shall be of approved manufacture & shall be fabricated from mild steel sections. These shall be double or single collapsible gates depending upon the size of the opening. These shall consist of vertical channel 20x10x2 mm of 10 cm centers braced with flat iron diagonals 20x5mm & top and bottom rails of T-Iron 40x40x6 mm with 38 mm dia steel pulleys or ball bearings in every 4th double channels, unless otherwise specified. Where collapsible gate is not provided within the opening & is fixed along the outer surface T-iron at the top may be replaced by flat iron 40x10 mm. The collapsible gate shall be provided with necessary bolts and nuts, locking arrangement, stoppers and handles. Any special fittings like springs, catches and locks shall be provided as described in the nomenclature of item in the schedule of quantities.

### **Fixing**

T-iron shall be fixed to floor and lintel by means of anchor bolts at 400 mm. Centers alternatively in two flanges of T-iron embedded in cement concrete of floor and lintel. The bottom runner shall be embedded in floor and proper groove formed along the runner for the purpose. The collapsible shutter on the sides shall be fixed by fixing the end double channels with T-iron rails and also by hold fasts bolted to the end double channel and fixed in masonry of the side on the other side. In case the collapsible shutter does not reach lintel, beam or slab, a T-section suitably designed be fixed at top embedded in masonry and provided with necessary clamps and roller arrangement at top.

### **Protection of work**

The contractor shall be responsible for the temporary doors and closing in openings necessary for the protection of work during progress. He shall also provide & maintain any other temporary covering required for the protection of Finished wood work that may be damaged during the progress of work if left unprotected.

### **Make Good Defective Work**

The contractor shall be responsible for any shrinkages or warping or any other defects which may appear in any joinery work. All defective or damaged work shall be taken down and renewed or repaired to the entire satisfaction of the Architect.

### **MS Railings, Grilles, Ladders, Gate:**

These shall be made from MS section as per the architect's details. The item includes fixing with screws or necessary anchor bolts and flats to fix the railing / MS members, holdfasts into Concrete (RCC 1:2:4) Pockets in walls / columns so that the members are rigid in position. The members shall be welded together and all the welded joints shall be filed to make smooth joints. The rate includes two coats of enamel paint of required shade and primer coat of red oxide. M. S. Bars used for rungs in ladders shall conform to IS : 432 and shall be fixed in position as per detailed drawings and directions of Project Manager / Engineer in charge.

## **09.0 ARCHITECTURAL FINISHING WORKS**

### **Structural Glazing**

#### **1.1 WORK INCLUDES**

Structural design and engineering fabrication, supply and erection of the structural glazing system including but not limited to the following:

- Extrusion aluminium framing members, Aluminium composite panels.
- All interior trim covers and closures including extruded furring panels. All anchor clips, fasteners and brackets.
- Glazing, including materials, gaskets, sealants, spacers and related work.
- All perimeter flashings and counter flashings contiguous to structural glazing.
- A continuous gutter system at each floor of the structural glazing.
- Field water tests
- Mock up tests.
- Samples as instructed by architect to be erected at site for approval.
- Interior Frameless toughened Glass partitions with SS handles & SS patching
- Interior Aluminum partition walls

#### **1.2 RELATED WORK**

- Metal fabrications
- Thermal Butt insulation
- Sheet metal flashing
- Sealants and Caulking
- Toughened and Annealed Glass installation systems
- Aluminium windows and doors
- Factory and or site glazing structural glazing

#### **2. REFERENCE STANDARDS**

All materials and workmanship shall comply with the following standard or equivalent bureau of Indian standards wherever applicable as a minimum and any other standards that are referred to herein in the document.

IS 875 (Part 3) - Code of Practice for Design loads for buildings and Structures part 3 wind loads.

AS 1288-1994 - Glass in buildings – selection and installation.

BS 6262 - Glazing for buildings.

AS 2208 - Safety glazing material for use in buildings.

ASTM C 1036 – 85 - For glass.

ASTM C 1048 – 87 - For heat strengthened and fully tempered glass.

AS 2047 – 1996 - Aluminium windows for buildings/code of practice For installation and maintenance of aluminium Windows in buildings.

AS 1664 - SAA Aluminium Structures code.

AS 2039 - Methods of testing anodic oxidation coatings on Aluminium and aluminium alloys.

AS 1580 - Methods of test for paints and related material.

AAMA 605.2 - Specification for high performance organic coatings.

### 3. **CODE COMPLIANCE**

Requirements of regulatory agencies: You must comply with applicable city and Indian Building codes and Regulations.

### 4. **STRUCTURAL GLAZING CONTRACTORS QUALIFICATIONS**

1. Work of the section shall be performed by one contractor, who is regularly engaged in the engineering, fabrication, finishing and installation of structural glazing including glazing and sealing of glass, comparable to work on this project. The contractor shall demonstrate to the satisfaction of Architects and Client that he has successfully performed comparable projects over the previous five years.

2. Sub-contracting any part of the work is specially prohibited, except for that which may be approved by the Architect in writing prior to award of the Contract. If approval is granted to sub-contract installation and / or glazing, approval is contingent upon the

supervision of his sub-contractor (s) by the same full time supervisor who coordinates and supervises mock-up work and installation at the project.

## **5. SOURCE QUALITY CONTROL**

Shop and field materials and workmanship shall be subject to inspection of the Employer and Architects and their representatives at all time. Such inspections do not relieve the Contractor from obligations to provide materials conforming to all requirements of the Contract Documents and industry standards for material quality.

## **6. DESIGN AND EXECUTION RESPONSIBILITY**

1. The contract documents define only the design intent and general performance requirements. The structural glazing contractor is charged with total responsibility for design, structural calculations, shop drawings, fabrications, installation, warranties, certifications and related documents.
2. Architects checking and approval will be only for general conformance to aesthetics and does not absolve the contractors from their responsibility for structural safety and finishes.
3. The structural glazing system manufacturer shall be entirely responsible for the design, fabrication and erection of the systems, and all work shall be performed entirely by his forces. No sub-contractor / labour will be allowed at site unless specific approval through written confirmation is obtained.
4. Design of metal framing members shall accommodate expansion and contraction of components without buckling, creating stress on glass, structural components & fasteners, joint seals or other damaging effects when subject to a surface temperature range of 5°C to 100°C.
5. Within two weeks of signing this agreement the contractor shall provide a detailed write up on the following: -
  - a) Conceptual design.
  - b) Component description.
  - c) Design, fabrication & execution details.
  - d) Detailed bar chart & showing all activities to last detail.
  - e) Method statement.

This is a performance specification. Drawings and specifications indicate the required basic dimensions, profiles and performance criteria. The contractor shall have the option to modify the details provided the visual concept and performance requirements are fulfilled. Proposed modifications shall be clearly shown on shop drawings, as “Design Modifications” and acceptance of same will not relieve the contractor from sole responsibility for performance of the metal wall cladding / structural glazing system.

## **7. PERFORMANCE REQUIREMENTS**

Design Pressures:

Pressure used for design shall conform to the stipulations mentioned in the relevant code of practice. Minimum design pressures, both inward and outward and acting perpendicular to glass (including return surfaces), shall be as per the requirements the Indian Wind Loading Code IS 875 part 3 (latest revision)

All components, assemblies and completed work included in or pertinent to the work of this section shall conform to or exceed the following performance standards and comply with all applicable and governing building codes and regulations.

Thermal Movement: Provide for noiseless contraction and expansion of component materials for an ambient temperature range from 10°C to 40°C without buckling, opening of joints, glass breakage, undue stress on fasteners, or other detrimental effects. Make allowance for vertical and horizontal expansion. Dimensions shown on the architect's drawings are based on a design temperature base of 30°C. For fabrication, account the ambient temperature range at the time of the respective operations and a daily temperature variation of 15°C.

Building movement and related building tolerances: The design and installation of the structural glazing system shall accommodate all inherent building movements and / or deflections and the fabrication and installation tolerances of all related work not involved in this section without the loss of, or any detrimental effect to, the performance requirements herein specified. The contractor shall verify and co-ordinate all such movements and / or tolerances with the applicable parties.

Water tightness: No water infiltration shall occur when subject to the effect of water sprinkler at 5 liters / minute / sq m for 10 minutes under the pressure of 150 kg / sq m for all fixed parts and 100 kg / sq m for ventilators. Double seal or pressure equalization system shall be provided to drain out any water, which may leak through the external sealing. Ventilator shall also be provided with proper drainage system, which may effectively drain out leaked water from the perimeter of the ventilator.

Air infiltration: The air infiltration shall not exceed 0.2 meter cube / hour / linear meter of ventilator perimeter when subject to a static pressure difference of 10 kg / sqm.

Thermal property: The structural glazing system shall comply with the maximum permissible OTTV of the overall external wall at 0.45 W /sq m. All insulation materials shall comply with the current requirements of the fire safely Bureau and other authorities.

8. **SUBMITTALS**

8.1 Shop drawings:

Prepare detailed shop drawings incorporating all allowances for construction and fabrication tolerances.

Submit detailed shop drawings for Structural glazing System to Architects for Review within 21 days upon award of contract.

Submit preliminary Shop Drawing with Tender Drawings showing all major Structural glazing System components.

Architect's review will be for conformance to the design concept and for the general arrangement only. Such review shall not absolve the contractor of any responsibilities as stated herein or any other applicable items herein specified.

Submit shop drawings for all work of this section, including mock-up. Show joinery techniques, provisions for horizontal and vertical expansion, glass and metal thickness, framing and anchor member profiles identify all materials including metal alloys, glass types, fasteners and glazing materials identify all shop and field sealants by product name and locate on drawings. Show relative layout of all adjacent walls, beams, columns and slabs with all dimensions to each other and grid lines dimension position of glass edge relative to metal daylight. Anchorage details to the building structure and coping details at the parapet are also to be submitted.

Submit die drawings for all gaskets, weather strips and Aluminium extrusions for record only and not for review.

Shop drawings shall be signed and stamped by the Qualified Structural Engineer with specific experience in Structural glazing construction and design.

No work shall be fabricated until the shop drawings, structural calculations and all other related submissions, documentation, certification samples and the mock-up for the work have been reviewed and approved by the Architect.

Sequence of installation shall be designated on the applicable plans, elevations and / or sections.

2 copies plus 2 reproducible sepia print each of all final approved shop drawings shall be submitted for the architect's and employer's use.

## 8.2 Structural Calculations:

- 8.2.1 Submit four (4) copies of structural calculations stamped and signed by a qualified structural engineer for all work of this section, including mock-up complying with current design rules of the relevant aluminium code include analysis for wind, dead loads, and it appropriate seismic loads on framing members and anchors. Show section, property computations for framing members and full size die drawings. The above should also be certified by the building structural engineer for deflection and structure adherence clearance.
- 8.2.2 Submit structural calculations for the structural silicon joint size as required for Aluminium profiles, silicone gaskets and glass bite must accommodate the silicone joint size required.

- 8.2.3 Glass analysis: Submit for record only glass manufacturers wind pressure analysis and thermal analysis showing that the specified maximum deflections and probabilities of breakage are not exceeded.
- 8.2.4 Suitability for Structural Silicone Glazing: Submit for record only glass manufacturer's written statement that any insulated glass; reflective glass and spandrel glass supported by structural silicone is suitable for such application.
- 8.2.5 Structural Silicone Substrate Tests: Submit for review the results of the structural silicone substrate tests.
- 8.2.6 Silicone Adhesive Tests: Submit for record sealant manufacturers test report for weather seal silicone adhesive to all relevant substrate. Test must include seven days water immersion after which silicone must have excellent adhesion to substrates. Report adhesion strength in terms of shear stress and tensile stress. Test samples shall simulate sealant joint sizes and configurations intended for production and execution.
- 8.2.7 Certification: Submit a letter of certification from the sealant manufacturer stating that the sealant has been tested for adhesion and compatibility on production samples of metals, glass and other glazing components and that all sealant details and application procedures shown on the reviewed Shop Drawings are acceptable for use.
- 8.2.8 Samples: Within three weeks of signing the contract the contractor shall submit samples for review three (3) sets of labeled samples of each required type and colour of metal finish, on 300m long sections of aluminium extrusion shapes. Samples must show extremes of colour texture variation.

Architects / Client will review samples for colour and texture only. Compliance with other requirements is the responsibility of the Contractor. Colour and texture range of production material shall match approved samples.

Architect reserves the right to require samples which will show the fabrication techniques and workmanship of the component parts and the design of accessories and other exposed auxiliary items, before fabrication of this work proceeds.

Within two weeks of signing this contract submit for review 3 sets of samples sealant backers, anchor components, anchor assemblies.

The following samples of actual job site materials shall be submitted in triplicate, unless otherwise noted, and in the sizes noted, for architect's review and approval. Any omission of an item, or item, which required the contractor's compliance with these documents, does not relieve him from such responsibility.

Aluminium sheet panel: Each type and thickness; 600 x 600 mm of specified thickness.

Aluminium extrusions: one only of each section; 300 mm long of specified thickness.



Glass: Each type and kind, 300 x 300 mm of specified thickness and including frame.

Glazing gaskets, tapes, separators, glass setting blocks, etc., each section 300 mm long or unit.

Fasteners and connecting devices: Each type and size.

Finish samples: After approval of the finishes & coatings provide the architect with 6 approved samples each of all colours in the applied coatings. Samples will be used to co-ordinate other work on the project.

Window and door ironmongers and accessories.

SS channel and finish samples.

Samples submitted should also include assembly of various components forming typical fixing details complete with flat sheets, glazing, extrusions, fastener, sealants etc.

Maintenance manual: Submit 3 copies each of detailed procedures for the periodic inspection, maintenance and cleaning of all applicable structural glazing elements, finishes, etc.

## 9. DOCUMENTATION

9.1 Glass and glazing documentation: The applicable glass manufacturer shall submit written certification for architect's review and approval stating that all glass and glazing requirements as detailed and specified on the shop drawings have been reviewed and approved for use relative to their specific application and / or design parameters, compatibility to adjacent materials and in conformity with all requirements as detailed and specified in the contract documents. Certification shall further state that the proposed glass and glazing materials are most appropriately suited for the use or uses intended and recommended for the specific use or uses. The glass and glazing requirements shall include the selection of the glass and the glazing materials including, but not limited to, gaskets, setting blocks, sealants, the design and dimensional parameters of the glass pockets and the compatibility of materials.

9.2 Sealant documentation: All sealant application must be clearly designated on the applicable shop drawing details and referenced to a master sealant schedule specifying materials, special instructions and application procedures. The applicable sealant manufacturer shall submit in writing that all sealant requirements as detailed and specified on the shop drawings have been reviewed and approved for use relative to their specific application and / or design intent, compatibility to adjacent materials and in conformity with all the requirements as detailed and specified in the contract documents. The manufacturer's certification shall specify the optimum life expectancy, in years, for the proposed sealant materials as detailed and specified on the shop drawings and / or master sealant schedule and shall further state that the proposed materials are most

appropriately suited for the use or uses intended and recommended for the specific use or uses.

- 9.3 Quality control documentation: In-plant and job site quality control procedures shall be documented in writing for architect's review and approval to ensure the design integrity and performance of the as-built product. Documentation shall include schedule, detail, isometric and / or schematic explanatory sketches cross-referenced to the shop drawings, data sheets, etc., all as required to intelligently witness and assess methods and materials and to ensure that both the fabrication and installation are in accordance with the contract documents.

The architect and / or his representative shall be given free access to the plant to inspect fabrication procedures. No fabrication or assembly of job site materials shall commence until the first production unit is personally inspected and approved by the architect.

The in-plant quality control procedures shall include but not necessarily be limited to, the following items:

- |              |   |  |
|--------------|---|--|
| Fabrication  | : | Tolerances, joinery, sleeves, etc.   |
| Finish match | : | Approved finishes and controls required for the match of exposed surfaces. |
| Assembly     | : | Welds, fastener, sealants, gaskets, separators, glazing, etc.              |
| Protection   | : | Handling, protection, shipping, etc.                                       |

The job site quality control procedures shall include, but not necessarily be limited to, the following items:

- |              |   |  |
|--------------|---|--|
| Anchorage    | : | Lines, grades and related building tolerances.   |
| Installation | : | Tolerances, finish match, joinery, sleeves, flashing, welds, fasteners, sealants, etc. |
| Sealing      | : | As recommended by the applicable sealant Manufacturer.                                 |

Protection & cleaning as recommended by the applicable material manufacturer.

## 10. DESIGN & ENGINEERING

The contractor for the aluminium and glazing work should possess adequate engineering background and facilitates inclusive of trained system personnel from their parent company and should be able to prove their design.

Where the structural glazing and other cladding impinges on intercepts, covers is attached to or supported by the work of other trades, the contractor's shop drawing and location drawings shall clearly distinguish elements and components of construction by others, the configuration, dimensions and location of which has been assumed. For example, where the configuration of a membrane, height of the hob or plane of finished stone veneer have not been resolved at the time of preparation of shop drawings, those elements shall be annotated as "Assumed alignment of membrane", Assumed height of hob relative F.F.L" Assumed face of granite relative to glazing line" and so on. In each instance, assumed surfaces and levels shall be dimensionally related to fixed surfaces or components of the cladding.

#### 10.1 Testing strength of embedded structural glazing anchors

In the event that the Architect or consultant rejects one or more embedded structural glazing anchors due to miss location, inadequate edge separation, unapproved modification, poor compaction or underlying concrete or any other matter related to the strength of the anchor, the contractor shall have the option of confirming the strength of anchor by the appropriate method as set out is ASTM standard E488-90; Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.

#### 10.2 Structural properties

The metal wall cladding / structural glazing element and all its related components shall be designed in accordance to Bureau of Indian Standards or equivalent.

No metal wall cladding / structural glazing elements including sealants and sealed joints shall sustain permanent deformation or failure under loading equivalent to 1.5 times the design wind pressure herein specified or the factor specified in code of practice which ever is higher.

Deflections: The specified deflections must be reduced if they affect in any way, cladding / structural glazing elements, sealants and / or sealant joints, glass and / or glazing, related components and adjacent structural and / or building elements.

The maximum deflection of design wind pressure shall not exceed 1/175 of ht. (Double glazed) and 1/125 of ht. (Single glazed) or 15mm whichever is lesser for mullion.

No deflection shall exceed 1/300 of space for glass supporting member.

#### Anchorage / support of metal wall cladding / structural glazing elements.

Wall braces, support steel and connection for support of metal wall cladding / structural glazing shall be designed, provided and installed complete. Supporting elements for the metal wall cladding / structural glazing anchorage assemblies to the structure, and all structural connections of the metal wall cladding / structural glazing shall conform to the following requirements.

Conform to the schematic layouts indicated on the drawings. The architects may permit variations from such layouts, but only if a proposed revision does not, in the architect's opinion, deviate from the design intent, cause excessive stress in the structure, cause excessive deflection, inhibit thermal and building movement or conflict with other requirements.

Member shapes and / or profiles on the architect's drawings are not necessarily the exact shapes required or best suited for the particular condition.

The height from the finished floor level to the top of the window sill shall not be less than 900mm. The horizontal or lateral load on such transom / railing shall be designed in accordance with the following criteria i.e., a horizontal UDL at 0.74 KN/sqm run, UDL supplied to the infill of 1.0 KN/sqm and a point load applied to part of the infill at 0.05 KN.

No holes shall be burned or field drilled in any structural steel members unless expressly approved by the architect / engineer in writing.

The contractor shall provide detailed layouts, alignments jigs, etc., for the proper and exact placement of all welded anchors, stud, anchorage, components, embedded anchor assemblies, etc.

All metal wall cladding / structural glazing elements and their applicable anchorage assemblies shall be designed to accommodate all thermal and building movements without any harmful effect to the metal wall cladding, as herein specified, including glass and glazing and sealant application and the structural glazing system.

No field forming, cutting and / or alterations of primary wall elements will be allowed. All framing members shall be shop fabricated and finish coated. No unfinished surfaces will be permitted on exposed surfaces.

### 10.3 Concrete tolerances

The metal wall cladding / structural glazing system shall be designed to accommodate the concrete tolerances allowable to the contractor who will be constructing the concrete structure. In case the tolerances specified hereunder exceed in the metal wall cladding / structural glazing design criteria then the contractor shall state the deviations in his tender.

The maximum tolerances of finished structural members, resulting from all human errors, limitations of materials and formwork, deflection of formwork, and any other factors that may affect the location, sizes and alignment of finish structural members shall not exceed that specified in BIS.

## 11. **WATER-SPRAY TESTING ON COMPLETION OF INSTALLATION (AAMA 502.1)**

A complete drainage system must be incorporated into the structural glazing frame. Water leakage and condensation shall be drained or discharged to exterior face of the wall

and all internal spaces vented by acceptable means to ensure air-pressure equalization where possible.

Drainage system will be sealed off per floor height to prevent infiltrated water from leaking to lower floors.

Movement of water behind and on exposed surfaces must be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to minimize the potential for algae and fungus growth as a result of standing or trapped water.

At the completion of structural glazing and glazed cladding installation, progressively in separable parts or in total, areas designated by the consultant shall be water-spray tested in compliance with the field test method set out in AAMA 502.1. All junctions between vertical walls and sloping glass shall be tested. Other areas for testing shall be designated at the completion and approval of installation. The contractor shall be responsible for supplying the designated test nozzle, appropriate hoses and water at sufficient pressure to conduct these tests. Cranes, mobile platforms, scaffolding and the like required for access to conduct field spray tests shall be provided by the contractor at his own cost. The structural glazing contractor shall give the Employer and consultant at least 14 days prior notice of completion of areas designated for testing.

## 12. **STRUCTURAL & WEATHERPROOFING SILICONE SEALANTS**

All silicone products used for structural glazing and weatherproofing of the construction wall shall be sourced from Dow Corning Corporation of Midland, Michigan, USA, its regional offices or local agents or equivalent sealant pre-approved supplier.

Silicone used for structural glazing, for other adhesive purposes within panels of the structural glazing system and for weatherproof seals within and between elements of the structural glazing shall be Dow Corning 795 one-part neutral cure structural grade sealant or equivalent sealant pre-approved supplier.

Silicone used for sealing and adhering metal smoke flashings, slurry dams, baffles, weatherproof flashings and moisture barriers extending between the reinforced concrete structure and glazed panels of the structural glazing system shall be Dow Corning 795 one-part neutral cure structural grade sealant or equivalent sealant pre-approved supplier.

Silicone used for site-applied seals between elements of the structural glazing and natural stone veneer cladding shall be Dow Corning 791-P one-part, neutral cure architectural grade sealant. Silicone used for perimeter seals to galvabond sheet metal backpans and within shadow-box spandrels shall be Dow Corning 791-P.

All joint sealants shall be chemically compatible with structural and weatherseal silicones. Spillage and splash of sealants on the members during fabrication of structural glazing panels shall be removed before curing.

Sealants used for weather seals shall not experience adhesive or cohesive failure. Sealants shall withstand movements up to the limits prescribed by the manufacturer. Exposed sealant surface shall not crack or bubble.

#### 12.1 Manufacturers tests of sealants

Provide to sealant manufacturer samples of all relevant substrates, including finished aluminium, coated glass, gaskets, setting blocks and brackets label and identify samples for this project.

Sealant manufacturer shall perform tests to verify adhesion, staining and chemical compatibility use sealants and substrates only in combinations for which favorable adhesion and compatibility results have been obtained.

Contractors shall submit for record only, sealant manufacturers written test reports, and recommendations regarding cleaning and priming.

The same should be carried out at the cost of structural glazing contractor. Copies of the result of the test reports should be made available within two months after signing this contract.

#### 12.2 Provenance

The structural glazing contractor shall retain and make available to the Architect / Consultant on request, documents identifying the source, production batch numbers, date of manufacture, date of purchase, date of delivery and date of use of all structural and weatherseal silicone products incorporated in the works.

To prevent excessive shelf life and facilitate the correlation of batches of sealant with panel production, silicone sealants generally shall be used in the sequence of their manufacture.

The structural glazing contractor shall obtain from the manufacture and supplier written confirmation of that

- (1) The material has not been subjected to temperatures in excess of 27°C for more than 12 hours during shipping or storage, or
- (2) The air temperature surrounding silicone sealants exceeds 40°C at any time during shipping or storage, or
- (3) Reliable temperature records are not available and a reasonable likelihood exists that the silicone has been subjected to temperatures in excess of 27°C during shipping or storage; such silicone shall be set aside and not used in the contracted works without the written approval of the manufacturer. Information relating to excessive temperatures shall be forwarded to Consultant / Architects and to the offices of Dow Corning Corporation in Singapore for the manufacturer's determination of the suitability of the product for the purposes set out in the specification and shop drawings and for the specific extension for its warranties or equivalent sealant pre-approved supplier.

### 12.3 Avoidance of cross-contamination

Where different silicone formulations are required for different purposes, the contractor shall take all necessary measures to ensure that only the documented and approved sealant is used in each application.

Silicone which cure by different chemical reactions or which release different chemical by products during cure (acetic acid, alcohol, amines and so on) shall not come into contact in fabrication, assembly and erection of the structural glazing system.

### 12.4 Correlation of sealant batch numbers and panel production

All prefabricated panels of the structural glazing and other cladding assemblies to receive silicone sealants at the factory shall be assigned unique and sequential serial numbers at the time of production. The serial number for each panel shall be recorded and correlated with corresponding silicone production batch or lot numbers and shelf-life expiry dates, the periods required for silicone cure and full adhesion in the typical ambient conditions of relative humidity and temperature at the contractor's factory, the date of panel deliver to site and the final location of the panel on the building façade. Serial numbers shall be legibly marked on panel surfaces visible up to full enclosure of the representative floors and concealed from view at the completion of construction of the building. Such marking shall be sufficiently permanent to resist the effects of sunlight and water and to remain legible throughout the period of construction of the structural glazing. Adhesive labels shall be permitted for marking of serial numbers provided that the relevant information can be understood on site without the use of bar-code readers.

Production batch numbers and storage life expiry dates for all structural and weatherseal silicones shall be recorded on delivery to the contractors factory and thereafter correlated with individual structural glazing panels by reference to production dates and panel identification numbers.

The contractor shall also supply to the testing laboratory one sample, not less than 300 mm by 300 mm, of each type of surface coated glass and laminated glass to be used in silicone-glazed assemblies. The results of testing shall be forwarded to Architects, within two months from the date of signing this contract. The cost of the sample and testing will be borne by the contractor.

Unless otherwise specified, submit for testing by Dow Corning Corporation samples of all materials which are to be attached, connected, supported, restrained, embedded in or sealed by the specified Dow Corning silicone products or equivalent sealant pre-approved supplier.

Testing of adhesion, chemical compatibility and stain-resistance shall be performed by Dow Corning (Singapore) in accordance with the Project Review requirement set out in the following document or the same by an equivalent sealant pre-approved supplier:

(Dow Corning Silicone Structural Glazing Manual, Form No.62-352-93, published in the USA, June 1993, available from Dow Corning Asia – India Liaison Office, 1102, Maker Chamber V, 221 Nariman Point, Mumbai 400 021).

Such testing shall be conducted, notwithstanding assembly or partial completion of components of the structural glazing prior to the issue of this specification.

Within a month from the date of signing this contract the structural glazing contractor shall obtain from Dow Corning or equivalent sealant pre-approved supplier and submit to Consultant / Architects certifying that the adhesive bond of the structural silicone has been satisfactorily tested on the contact surfaces of representative samples of the anodized aluminium framing system and coated surfaces of the specified / approved glass. The test results shall be:

- Citing the test values obtained;
- Stating the requirement for primers (if any);
- Stating the minimum silicone cure period during which structural glazing elements must not be moved. The statement shall allow for the specific climatic conditions of Bangalore;
- Certifying that the structural glazing contractor and sub-contractors (if any) are qualified to apply structural silicone adhesive and experienced in its use;
- Certifying that the structural silicone sealant is chemically compatible with and will not cause de-lamination or visible change in the appearance of the polyvinyl butyral interlay of laminated glass;
- Certifying that the structural glazing adhesives have been satisfactorily tested to ASTM C 1087 for compatibility with all other materials, components and accessories of the structural glazing system with which they come into contact and that such contact is not detrimental to long-term structural performance, weathering performance and visual quality. Such certification shall include but not necessarily be limited to synthetic rubber setting blocks, side blocks, anti-walking blocks, form and solid glazing tapes, double-sided adhesive tapes, backer rods, preformed gaskets and seals;
- Certify the use of non-volatile materials in spandrel zone;

Within two months from the date of signing this contract the structural glazing contractor shall provide a statement certifying, and showing by means of calculations, that the structural glazing sealant design satisfied Dow Corning's published design requirements as applicable to the structural glazing system. The maximum permissible working stress of structural sealants shall be within the permissible values. If structural silicone supports the dead load of glass in any configuration, the dead load design strength shall be limited to 6.9 kPa. Calculations shall confirm that the structural glazing system has been designed to provide a structural sealant bite sufficient to restrain the glass at 150% of the permissible stress design wind loads, both positive and negative, derived from the regional and local wind speed data provided by the architect or otherwise as cited by IS 875 – Code of Practice for Design Loads for Buildings and Structures – Part 3; Wind loads.

Unless otherwise approved, the minimum dimensions of all weatherseals and structural silicone seals shall be:

Adhesive plane width (also known as bite) : 6 millimeters



Sealant bead depth (also known as glue Line thickness) : 6 millimeters

Permitted exceptions : Vision glass sash details which Incorporate weatherseals, the Depth of which is controlled by 1.5mm double – sided adhesive foam tape located outboard of conventional rectangular structural sealant beads.

Unless otherwise approved, the adhesive plane width must be equal to or greater than the sealant bead depth.

### 13. THERMAL INSULATION IN SPANDREL ZONE

Thermal insulation in spandrel shadow boxes shall be 50 mm thick chemically inert semi-rigid black-faced mineral wool or fiberglass butts with a density of 60 kilograms per cubic meter. Insulation butts shall be mechanically restrained along all edges to maintain a regular air space of not less than 40 millimeters between the inboard surface of spandrel glass and the black facing of the insulation.

**Note:**

Some organic components of contact adhesive and plastic tapes, such as triphenyl phosphate fire retardant, are known to evaporate at high temperature within shadow box spandrels and later condense on surface # 2 of spandrel glass. This phenomenon, now known as spandrel glass volatilization, can cause vivid iridescent reflections of daylight on glass which otherwise appear dark.

Insulation within every spandrel shall consist of a single panel of mineral wool or fiberglass without butt joints. Insulation shall be fixed vertical, flat and at a constant distance from the glass such that undulations and other deviations cannot be discerned when viewed from the exterior at ground level in acute glaring sunlight.

Adhesive tape shall not be used to secure, join or repair insulation butts. If the specified black facing consists of a separate layer, sheet or scrim adhered to un-pigmented insulation, obtain from the manufacturer certification that the composite material does not contain chemicals or compounds which evaporate and condense at the service temperatures likely to occur within the spandrel. Do not attempt to repair insulation butts with creased, torn, frayed or otherwise damaged black facing. Damaged insulation butts shall be discarded.

Where open-cell or other double-sided foam glazing tapes face into the spandrel shadow box, obtain from the tape manufacturer certification that the form and its adhesive do not contain chemicals or compounds, which can evaporate and condense at the service temperatures likely to occur within the spandrel.

All thermal insulation shall be fully and continuously sealed within the spandrel by the corresponding backpan of 1.2 mm galvabond steel sheet prior to removal from the contractor's factory. Perimeter seals to the backpan shall consist of a continuous bead of Dow Corning 791-P silicone.

Should it be necessary to remove, replace or repair the backpan of the spandrel after installation on site, the surrounding area shall first be cleared of any material or activity which gives rise to machine oil, lubricants, liquid coolants, metal filings, drillings, angle grinder swarf, weld spatter, cement dust, cement slurry, plaster, paint, detergent, water or other liquids. In the event that impact against the backpan of an installed spandrel panel dislodges thermal insulation, the contractor shall submit to the architect for approval a detailed description of the proposed method of repair and resealing.

#### Plastic components within the spandrel zone

Shadow box spandrels shall be ventilated to the exterior of the building through holes drilled in enclosing mullions. Ventilation holes shall be located close to the top of the enclosed space.

No rigid, flexible or plasticized polymeric materials other than the approved silicone sealants and glazing tapes shall be enclosed within or face into the spandrel shadow box.

#### 14. **SURFACE PREPARATION, INSTALLATION AND CURING**

(Unless otherwise specified, surface preparation, installation and curing of silicone sealants shall comply strictly with the recommendations published in the following product information sheets:

Dow Corning 795 Silicone Building Sealant, Form No. AA-0583-HK96, Published by Dow Corning Corporation, March 1996, available from Dow Corning Asia-India Liaison Office, 1102, Maker Chamber V, 221 Nariman Point, Mumbai 400 021.

Dow Corning 791-P Silicone Building Sealant, Form No. AA-0586-A97, published by Dow Corning Corporation, March 1997, available from Dow Corning Asia-India Liaison Office, 1102, Maker Chamber V, 221, Nariman Point, Mumbai 400 021.

Silicone sealants shall not be applied to damp surfaces. The surfaces to which silicone is applied shall be free from all foreign matter and contaminants such as grease, oil, dust, water and other liquids, resin from timber shipping crates, perspiration, rust, angle-grinder swarf, surface dirt, residues of protective coatings, masking tape adhesives and extraneous glazing compounds.

Backing rods and tapes shall consist of open-cell polyurethane or closed cell polyethylene foam compressed to not more than 50% of the unstressed diameter.

#### Maximum temperature of substrates

**Note: The surface temperature of black anodized aluminium and reflective coated tinted glass exposed to sunlight can exceed the maximum recommended application temperature for structural glazing and weatherseal silicones.**

Silicones sealants shall not be applied to materials with a surface temperature exceeding 50°C. The structural glazing contractor shall procure, maintain and make available on request a digital electronic contact thermometer of the stainless steel ribbon contact type. The contractor shall make record representative measurements to ensure that the surface temperature of anodized aluminium and coated glass elements does not exceed 50°C at the time of sealant application. As necessary, metal and glass surfaces exposed to sunlight shall be shaded to reduce their temperature below 50°C at the time of site-application of silicone sealants. Such shading shall be maintained in place and without contacting the silicone for a period of three days after application of the sealant.

Water spraying, evaporative cooling, covering with wet fabric and the like shall not be used for controlling the temperature of elements to receive silicone sealants.

#### 15. **SITE APPLICATION OF SILICONES**

It is the intent of the contract that on-site application of structural silicone be minimized wherever the alternative of factory application is readily available. The contractor shall observe this as general principle. The contractor shall maintain and secure a set of elevations and other drawing sufficient to record accurately the location of all site application of structural silicone including site re-glazing. At the time of practical completion of the structural glazing and all other structural silicone glazing covered by the contract, the contractor shall prepare and submit to the Employer and Architect a complete set of drawings recording the location of site-applied structural silicone and site re-glazing.

Site applied silicone weatherseals and structural adhesive shall be protected from dust, soiled rainwater, cement slurry and the like until exposed surfaces which come in contact with the sealant are fully continuously and cleanly masked and unsoiled.

Note: The glazier, sealant applicator and other workmen employed by the contractor shall be skilled and sufficiently trained in the respective trade by the manufacturer or a reputed training institute.

Only proper tools shall be used. Using plastic cartridges of tubes to tool silicone sealants and retrieving excess material for re-use is strictly prohibited.

#### 16. **ACCESSORIES**

Extruded gaskets, weather stripping, extruded seals and spacers, which do not come into contact with structural silicone sealant, shall be of ethylene propylene diene monomer (EPDM) or Santoprene. Where in parallel contact with structural silicone sealants, all gaskets, setting blocks and spacers other than foam glazing tapes shall be heat-cured silicone rubber, chemically compatible with the silicone sealant and suitable for the specific purpose intended. All extruded gaskets, weather-stripping and spacers other than

glazing tapes shall have continuous mechanical engagement to framing members; adhesive attachment is not acceptable. Unless otherwise approved, gaskets, weather stripping, extruded seals and spacers shall have a hardness of 40 +/- 5 durometer Shore A.

The cladding system shall be constructed with (and shall maintain during its design life) a standard of seal, which shall not result in any reduction of sound insulation performance.

Gaskets, weather stripping and seals used to achieve the required weatherproofness and / or air tightness shall be selected to accommodate fully the range of dimensional tolerances associated with fabrication and installation of the cladding system. Gaskets, weather stripping and seals shall be formed from materials capable of retaining their elastic qualities, dimensions and resistance to physical and chemical attack sufficient to maintain complete watertightness, air tightness and acoustic performance for the design life of the structural glazing.

Note: Extruded synthetic rubber gaskets, weather-stripping, seals and so on are often drawn into and along tight-fitting flutes or channels in aluminium framing extrusions. One unforeseen result is that these elastomeric materials are stretched and held in tension by frictional contact with aluminium at the time their ends are trimmed. As frictional restraint diminishes through cycles of temperature change, movement and wetting, the gaskets retract along their major axis to an unstressed state, leaving gaps at their ends through which water and air infiltrate. Household liquid detergents are sometimes used to lubricate synthetic rubber extrusions. These materials can be trapped in extrusion flutes and later run down the interior surface of spandrel glass, leaving a drip trail of highly reflective flakes which may damage glass coatings and give the appearance of cracks in the glass. These shall be avoided.

Setting blocks shall be dense heat-cured rubber with a hardness of 80-to 90-durometer Shore A. Side blocks and anti-walking blocks shall be dense heat-cured silicone rubber with a hardness of 60 to 70 durometer Shore A.

## 17. FINISHES AND COATINGS

### Structural glazing framing members, trims and attachments.

Hard coat anodize of all surfaces of aluminium components of the structural glazing other than load-braking brackets between the structural glazing and concrete structure shall be in accordance with AS 1231 – Specification for Anodized Aluminium.

All sections shall be of anodized finish. All anodized sections shall be of alloys and temper compatible with the selected anodizing system and specified colour. The structural glazing contractor shall provide written confirmation by the anodizer that the alloys to be treated are appropriate for the required finish and colour. Finished extrusions shall match the colour samples approved by the Architect.

Framing components and trims may be cut from previously anodized stock length extrusions provided that no cut surfaces are visible or exposed to weather in the final assembly.

The surfaces of all aluminium components to be anodized shall be degreased, caustic etched to a matt finish and chemically cleaned. The minimum thickness of the coating shall be Grade AA25 (25 microns). Density of the coating shall not be less than 2.72 gm/cc.

After anodizing, the components shall be properly sealed and thoroughly rinsed in clean running water. When dry, the surfaces shall be uniform in appearance, free from stains, smuts, scratches, blemishes and deposits of caustic or acidic substance.

The structural glazing contractor shall provide written independent certification that the specified thickness of anodizing has been attained. All testing and measurement of anodized coatings shall comply with AS 2039 – Methods of Tested Anodized Aluminium Finishes. The employer and its agents shall conduct independent measurements of anodized coating thickness at the structural glazing contractor's plant and on site. Coating thickness of less than 20 microns on any visible or exposed aluminium surface shall constitute a defect requiring removal and replacement of the component.

The structural glazing contractor shall prepare and execute a quality management program to confirm adequate adhesion of structural silicone sealant to relevant anodized framing members. Testing shall be performed at the anodizing plant on every batch. The contractor shall record test results and submit all data, including that for rejected components, to the architect prior to the commencement of cutting or machining anodized stock length extrusions. No anodized material shall leave the anodizer's plant prior to the quality control tests being completed for the batch.

**Additionally the following shall be followed:-**

Mechanically buffing and polishing of the surface to remove mill scale and surface scratches wherever necessary shall be carried out.

Etching in alubrite solution at a constant temperature of average 65°C to give uniform matt surface finish.

Anodizing in H<sub>2</sub>SO<sub>4</sub> diluted electrolyte solution, temperature maintained at 20°C average DC current process at an average of 14 AMP per sq ft to achieve an average of 25 micron hard anodic coating.

Colouring with West German formulation with Electro-chemical Salts in electrolyte solution without the use of any pigment or dye so as to achieve integral non-fading colouring of the anodized metal finish.

Hot sealing in de-ionized water bath at constant temperature of 98°C.

- **Provide movable joints to accommodate the full range of manufacturing tolerance, field tolerance, thermal movement, floor sag, beam sag and column settlement and concrete.**

**Joints shall accommodate the worst possible combination of effects so as to prevent internal stress, failure, deterioration or failure of weather seals. It is the responsibility of the structural glazing contractor to verify the slab deflection with Architects / Consultants before finalizing the design.**

- **Thermal components of joint movement shall be based upon a minimum material temperature increase of 50°C and decrease of 50°C relative to the time of installation. Design for these assumed temperature changes regardless of surface areas exposed to the exterior and interior. Assume the entire cross section has uniform temperature. For thermal design other than joint movement, design for the winter surface temperature shall be 99% design dry bulb winter temperature from the ASHRAE handbook; the design summer surface temperature shall be at least 100°C. All components including adhesives and sealants shall be capable of withstanding, without failure, design winter temperature to design summer temperature with simultaneous specified loads.**
- Design for seismic movements as required by code and as specified herein. At any given floor, the maximum seismic displacement shall be assumed to occur while the floors immediately above and below remain in an un-displaced condition. For seismic displacements upto and including the maximum value there shall be no failure or gross permanent distortion of anchors frames, glass or panels, weather seals Design seismic displacement shall be 19mm.
- **It is the responsibility of the structural glazing contractor to establish the joint width and to verify the seismic displacement requirements with Architects.**

#### 18. **PRODUCT HANDLING**

- The structural glazing contractor shall indicate procedures within two weeks of signing this contract.
- Package and store materials in a manner that will prevent surface damage or contamination, distortion, breakage or structural weakening.
- Replace any material damaged during manufacture, shipping, storage or erection.
- Protect materials in place from contamination and damage.
- Protect factory applied finishes from staining and scratches.
- Field cutting of anodized / powder-coated components shall not be permitted.

#### 19. **INSPECTION**

All shop and field materials and workmanship shall be subject to review by Architects and Employer at all times. Such reviews shall not relieve the Contractor from the obligation to provide materials conforming to all requirements of the Contract Documents, and matching approved samples. The contractor shall promptly correct any deficiencies reported and carry out his own control measurements for all materials, whether reviewed or not.

#### 20. **WARRANTY**

Submit written warranty agreeing to repair, replace defective materials and workmanship during the warranty period. Defective materials and workmanship include abnormal deterioration, aging or weathering of the work, leakage of water or air, structural failure of components resulting from exposure to pressure and forces up to specified limits, failure of operation of parts to function normally, deterioration or discolouration of finishes, glass breakage, secondary glass damage or breakage due to falling glass fragments, deterioration of glass reflective coating, cracking, staining, chipping and discolouration of granite and other cladding material, adhesive or cohesive failure of silicone sealant, and failure of the work to fulfill other specified performance requirements.

The warranty does not include damage caused by vandalism. This warranty and its enforcement shall not deprive the Employer of other action, right or remedy available to him.

The general warranty period is ten (10) year period after the date of final acceptance. The warranty period for peeling or deterioration of glass reflective coating shall be ten (10) year period after the date of final acceptance. The warranty period for material observation of vision glass as a result of dust or film formation on the internal glass surfaces is minimum of twenty (20) years after the date of final acceptance. Sealant warranty shall be for 20 years.

The anodized finish is included in the general warranty of 10 years.

Alloy for aluminium extrusions shall satisfy requirement for 6063-T5. Standard commercial tolerances shall apply to finished, fabricated and assembled materials. Stricter tolerance shall apply where required to assure proper functions of glass and glazing materials. The wall thickness should satisfy all structural requirements.

For support brackets use 6061 T5 structural grade. All aluminium brackets to have serrations.

## 21. **FABRICATION**

GENERAL: All assemblies shall be fabricated and assembled in accordance with the drawings and the requirements of these specifications. Deviations of any nature, without approval of the architect, shall not be permitted.

Competent workmen who are thoroughly skilled in their trade shall do work. Assemblies shall be neat and free of defects that impair strength, function or appearance. The work shall be accomplished in compliance with the specified criteria without buckling, opening or joints under stress on fasteners, sealants and gaskets, opening of welds, cracking of glass, leakage, noises and other harmful effects.

As far as practicable, fitting and assembly of the work shall be done in the shop.

All exposed work shall be carefully matched to produce continuity of line and design. All joints in exposed metal work, unless otherwise shown or specified, shall be accurately fitted ends rigidly secured with joint sizes conforming to industry standards.

Except where otherwise shown, specified or directed, the method of assembly and joining shall be the Contractor's option provided the results are satisfactory. The manufacturer's proven methods that will produce the required standards of workmanship shall be used subject to approval. Fabricate and fasten metal work so that the work will not be destroyed nor the fasteners over stressed from the expansion and contraction of the metal.

All welding shall be in accordance with the appropriate recommendations of the Indian welding codes and shall be done with electrodes and / or by methods recommended by the manufacturer of the alloys being welded. All welds behind finished surfaces shall be done as to minimize distortion and / or discoloration on the finished side. All weld spatter and de-scaling and / or grinding shall remove welding oxides on finished surfaces.

Unless otherwise shown or specified, all weld beads of exposed surfaces shall be ground and finished to match and blend with finish on adjacent parent metal. Grinding and polishing of nonferrous metal shall be done only with clean wheels and compounds free from iron and iron compounds. No soldering and / or brazing shall be allowed. Conceal fasteners where visible in the finished work.

Fabricate aluminium components before finishing. Components cut in the field will not be acceptable.

## 22. EXECUTION

### Inspection:

Verify that surface and conditions are suitable to receive the work of this section, and that condition will not adversely affect the installation and performance of the installed work.

Correct all unsatisfactory conditions prior to beginning erection of specified work.

### Execution generally:

The architect's drawings shall be considered essentially schematic, except for profiles of exposed surfaces which shall be as indicated. If, in the opinion of the contractor, a change of profiles is required in order to meet the specifications, he shall consult with the architect for a review of the conditions.

The method of assembly, reinforcing and anchorage of the metal wall cladding / structural glazing system, where indicated, is schematic. Location and method of providing same shall be the contractor's responsibility, who shall design, assemble, reinforce and anchor to suit each specified condition in an acceptable manner complying with the requirements specified herein and the works that are to be interfaced with main building structure shall be co-ordinated according to main contractor's program.

Visible joints shall be as shown on the architects drawings.



All parts shall be secured by concealed means and screws exposed to view shall not be allowed.

All components shall be assembled, secured, anchored, reinforced, sealed and made weather tight in manner not restricting thermal or wind movement of the metal wall cladding / structural glazing system. Where possible, sealants shall be concealed.

Free and noiseless movement of all components of the metal wall cladding / structural glazing system due to thermal structural, wind pressure or dead loads, shall be achieved without strain to glass, without buckling of any components and without excessive stress to any members or assemblies.

The entire metal wall cladding / structural glazing system shall be assembled and installed so that all leakage and condensation shall be drained and discharged to the exterior face of the wall.

Movement of water behind and on exposed surfaces shall be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to minimize the potential for algae and fungus growth as a result of standing or trapped water.

## 23. **ERECTION**

Erect structural glazing and aluminium drain system in accordance with the approved shop drawings.

Provide labour, material, booms, accessories and supervision necessary to erect the complete material.

Co-ordinate erection with the requirement of the hoist man lift, including tie back and kicker connections to the floors, if applicable and door openings at the various floor.

Do not install components, which are defective in anyway, including warped, bowed, dented, abraded and broken members and glass with edge or surface damage.

Remove and replace all damaged components to Architects satisfaction.

Set wall plumb, square, level and fasten securely in correct vertical and horizontal alignment. Seal joints within wall and between adjacent constructions.

Do not cut, trim or weld components during erection in any manner, which would damage the finish, decrease strength or result in a visual imperfection or failure of such components.

Return components, which require alteration to the shop for re-fabrication or from the replacement with new parts, or components.

Install components to level, plumb, true to line and with uniform joints. Attach to structure with non-staining and non-corrosive anchors, fasteners, spacers and fillers as required.

All scaffolding material used to erect the system shall be of MS props, H frames and planks secured firmly and safely.

#### 24. TOLERANCES

Tolerance for building frame and other work are specified in other sections make provisions for these tolerances, including a +/- 25mm concrete slab tolerance.

All parts of the work when completed shall be within the following tolerances.

Diameter of pocket shall not exceed 1 mm.

Provide accurate benchmarks for use in wall erection of all floors promptly correct any errors or inconsistencies.

Furnish a schedule of fabrication tolerances for all major wall cladding components. In addition to the fabrication tolerances, provide for and schedule thermal movement including assembly and installation tolerances for all major wall cladding components and / or assemblies.

#### 25. ASSEMBLY AND ANCHORAGE

Anchor component parts securely in place by bolting welding or other permanent mechanical attachment system, which will comply with performance requirements and permit movements, which are intended or necessary install slip pads between moving parts.

Provide a separator at contact surface of dissimilar material wherever there is a possibility of corrosive or electrolytic action.

Remove weld slag and apply prime paint over welds. Also paint exposed portions of inserts. Touch up shop applied paint that is damaged by welding or other causes.

Anchorage system and building frame: Each mullion shall be fixed to the structural slab at each floor level. All steel fasteners shall be galvanized, coated with zinc chromate primer and supplied by the contractor. Any bolts or angles to be cast in concrete shall be supplied and delivered to site by the contractor and check the building frame and the exact position of fixing bolts or angles on site. The contractor shall also make necessary modifications to the anchor ties to suit different site conditions of steel reinforcement without additional charge.

Shop assembly: As far as practicable, all fitting and assembly of the work shall be done in the shop. Work that cannot be permanently shop assembled shall be temporarily

assembled in the shop and marked, before disassembly to ensure proper assembly later in the building.

Sleeves: Unless otherwise noted, all aluminium sleeves shall be extruded sections designed to accurately interlock with adjacent sections and incorporate serrated surfaces for the secure bedding of sealant between the parent metal and the sleeve.

Fasteners: All fasteners shall be stainless steel with self-locking devices, unless otherwise noted, and of sufficient size and strength to withstand the applicable design wind load and dead load forces with safety allowance factors as required for the specific materials. The spacing and quantities of fasteners shall be as required to develop the maximum strength of the member they secure or support. Washers and / or other accessory items shall be of the same material as the fastener. Use torque wrench for all assembly fasteners to achieve the maximum torque-tension relationship in the fasteners.

All fasteners shall be concealed unless otherwise shown or approved. The head style for all exposed fasteners shall be countersunk oval head unless otherwise noted on the drawings. Exposed fasteners shall be finished to match surrounding metal finish.

All fasteners including washers and accessory items shall be scheduled and designated on the shop drawings so that anyone can witness and assess the assembled units to ensure that all fasteners conform to the designated and approved type, size, material, spacing, etc. When certain items are not readily apparent, such as material and alloy or torque tightening requirements, special instructions for the identification and appraisal of such items shall be issued.

## 26. SEALANT APPLICATION

Apply sealant materials in accordance with sealant manufacturer's recommendations.

Apply sealant using a continuous bead of sealant between flashing and adjacent construction.

## 27. GLAZING

Preparation: Clean all surfaces, which will be in contact with glass immediately prior to glazing. Remove all dirt, oil and other bond reducing film. Use cleaning material only as recommended by the structural glazing manufacturer.

All glass shall be new. Mock-up glass shall not be used in the building. Glass used shall be with seamed edges and corners. Inspect all lights of glass before installation.

Before setting glass, inspect frame for proper dimension and angles. Adjust frame and / or glass size as required to meet specified requirements.

Thoroughly clean glazing pocket before setting glass. Solvents shall be compatible with aluminium, glass and glazing materials. Place setting blocks at quarter points. Place side

blocks in the upper half of the each jamb light. Side blocks shall be positively retained in position.

Remove and replace stops and apply sealants as required for a complete glass after the construction period.

Defer glazing of openings, which are obstructed during construction. Glaze such openings when obstructions are removed.

Replace any glass, which breaks or sustains edge damage surface damage or damage to reflective coating as defined above.

## 28. PROTECTION

Take all necessary means to prevent any damage (scratches, dents, nicked edges, etc.) to components during handling and erection.

Replace components beyond acceptable field repair at no additional cost to the Employer.

Protect glass from breakage immediately upon installation or attachment of crossed streamers to framing held away from the glass. Do not apply markers of any kind to glass surfaces.

Maintain glass in a clean condition at all times including during construction to prevent glass damage from corrosive action from the elements and contributing side-effects (by wash-off) to other components and other work.

## 29. CLEANING

Clean surfaces as required removing corrosive substances. At the conclusion of construction, clean all surfaces to the satisfaction of Architects and Employer.

Provide written verification that cleaning agents are compatible with aluminium, glass, glazing materials and sealants.

Periodically remove from the site debris, excess materials and unused tools and equipment resulting from this work. At the conclusion of construction, leave the premises in a clean condition acceptable to Architects and Employer.

All debris caused by or incidental to the installation work shall be promptly removed from the job site as the work progresses. Weep holes and drainage channels shall be unobstructed and free of dirt, rubbish and sealants.

## 30. ALUMINIUM & GLAZING

Structural Glazing System

All aluminum window, doors, structural glazing, etc., are to be from a system, custom designed for optimum performance. These windows, doors and structural glazing should exceed the performance standard requirements at AAMA whereas the depth of the profile shall be determined by adequate structural calculation. Windows in general shall not produce any whistling noise due to wind forces and also be free from rattling of the shutters. Adequate water drainage as well as pressure equalization methods shall be adopted in the system design to avoid water penetration and air infiltration. A guarantee of 10 years will be required for the system.

Aesthetically the design of the structural glazing system is to provide a filtering envelope to a building and to give uniform appearance. The structural glazing system design shall be capable of accommodating dead loads and wind loads and other movements without reducing its performance or causing permanent damage. The structural glazing's own dead loads and the loads occurring due to wind forces acting on them shall be transferred to the structure at its anchorage points.

The system design shall accommodate a standard temperature range of + 10°C. The system design shall be capable of incorporating seismic joints, to deal with earthquakes. The structural glazing system shall allow the structure deflections shall also accommodate variable deflection limits.

The structural glazing system shall be proprietary as shown on detail drawings with possibility of re-glazing of vision panels from inside the building using sub shutter glass panel unlock systems. The whole system design parameter is to install the structural glazing system from the inside of the building.

All nuts and bolts are to be tightened to requisite torque using a torque spanner/calibrated electric screwdriver. All spandrel area will have GI metal sheet formed tray filled with rock wool of 50mm thickness fastened by using dynastic fasteners. Necessary fire and smoke barriers to be incorporated at every slab by using Rocksil, fire protection slab material and fire retardant silicone.

The whole structural glazing system has to be designed on the rain screen principle with pressure equalization provisions.

In order to facilitate thermal expansion, vertical mullions shall have expansion joints at every second floor level.

Structural design criteria will be based on basic wind speed data available as per IS 875 with correction factors applicable.

Contractor has to submit structural calculation upon signing this contract.

### **System Assembly**

All mitred joints in the framework shall be crimped using an adequate insert and corners are to be sealed with Terecon / 3M adhesive metal corner sealant. All straight joints to

have EPDM flap gaskets at the joint to avoid water leakage. All screws in the assembly and installation shall be fully concealed and made of stainless steel.

### **System Accessories**

All systems accessories are to be purpose designed, part of the system product and shall operate smoothly for the whole of the guarantee period. Side hung windows while locked shall be properly closed and tightly and will lock at minimum three points in the frame. Side hung windows will also incorporate center gasket. All sliding window rollers shall be ball bearing type with Teflon outer body shell.

### **Gaskets**

All gaskets are to be part of the system and shall be formed of Neoprene or EPDM or silicone with a minimum design life of 10 years. All gaskets corners and joints are to be vulcanized to form a single piece.

### **Special Construction**

Structural glazing should incorporate floor-to-floor noise isolators, fire and smoke stops, sill flashings, etc., and the whole design, engineering and installation shall be subject to the engineer's satisfaction and approval.

## **31. DOCUMENTS REVIEW**

Performance tests: It will be contractor's responsibility to provide shop drawings, supporting calculations and test units to the client at site.

Glass replacement: Contractor's indemnity has to include supplying and installation of any failed units including glass breakage free of charge during the defects liability period indicated elsewhere in the document.

Indemnity of water and air tightness: Contractor indemnity has to include making good and defects / water and air leakages during the defects liability period. The client should have the option of extending the warranty for another 10 years the same should be provided under additional indemnity insurance.

## **32. TECHNICAL DESCRIPTION**

### **Structural glazing:**

The structural glazing system shall comprise of pre-fabricated units with vertical mullions at the partition grids.

The window unit connection has to be designed to support the dead and live loads transferred from the window units themselves.

Window profiles have to incorporate structural silicone sub-frames in order to permit re or de-glazing from outside and to eliminate any, need for applying silicone on site. The factory pre-glazed sub-frames have to be held in stock against any further needs.

Glazing gaskets (internally) to be of one-piece vulcanized tyre functioning as air and vapor barriers.

The structural glazing mullions and transoms are not to be designed as guides for 'Gondolas'. However, socket type 'Gondolas' shall be allowed and prior approval of architect / consultants should be obtained before making provisions in the frames.

Glass breakage:

The contractor shall replace all broken, damaged and disfigured glass caused in executing the work or by faulty installation before acceptance of the building without cost to the client.

Re-glazing:

Re-glazing procedures should be considered during the initial design of the structural glazing system. Should vandalism or an unfortunate breakage of glass occur for some unknown reason, the appropriate steps for re-glazing should be taken to maintain public safety and proper operations of the building.

Field adhesion test (structural sealant):

As a check for adhesion, a hand pull test may be run on the job site after the sealant is fully cured (usually within fourteen to twenty-one days).

The hand pull test procedure is as follows:

1. Make a knife cut horizontally from one side of the joint to the other.
2. Make two vertical cuts approximately 50 mm long at the sides of the joint, meeting the horizontal cut at the top of the 50 mm cuts.
3. Grasp the 50 mm piece of sealant firmly between the fingers and putt down at a 90-degree angle or more, and try to pull the uncut sealant out of the joint.
4. If adhesion is proper, the sealants tear cohesively within it before releasing from the substrate.

Note: Adhesion may be adversely affected by:

- a) Moisture on the substrate during sealant application and cure.
- b) Contaminated or weal surfaces.
- c) Poor application technique.

### Cleaning:

The PVC tape wrapping, protecting the anodized finish shall be retained till the glazing work is completed. After the glazing and all work connected with installation is complete, all aluminium work shall be washed with a suitable thinner and left in a finished condition, in approved uniform appearance and free from all marks and blemishes. All surfaces of aluminium exposed after glazing should be with PVC wrapping and removed before handing over only.

Ensure that cleaning methods and solutions used will not be detrimental to any elements of the structural glazing system.

Inspection during building construction is the responsibility of the contractor. The contractor should coordinate with the other civil works relating to his job. Therefore inspection during the construction is very important, affecting the structural glazing with the layout of the building frame to which wall it is attached.

It is therefore essential that regular inspection be continued throughout the structural glazing installation process to ensure proper correlation to all work related to the structural glazing.

The structural glazing contractor must accurately establish reference points and lines on each floor by which to line his work. These marks should be scored into columns, slabs to ensure permanent legibility. Markings as noted must be accurately located wellhead of the installation of the structural glazing to avoid errors and delays in the work.

It is the responsibility of the general building contractor to establish and guarantee the accuracy of such offset lines and benchmarks.

### Working condition:

Proper working conditions and facilities are essential for efficient wall installation and the contractor should coordinate with the general civil contractor to ensure that following requirements are kept or followed:

1. Floors are kept clean, free from debris and rubbish
2. Adequate area for storage of structural glazing materials in each floor
3. Electricity for operating small tool on each floor.
4. Precaution to structural glazing materials, both before and after installation from dust and damage.

The above are the responsibility of the general civil contractors.

### Maintenance and inspection:

Maintenance during the initial construction of the structural glazing system should be done by the glazing contractor to ensure that the system is properly installed and that all



of the structural sealants have the proper conditions for curing. Inspection of the system should occur periodically to ensure that there is no adhesion loss or cohesive failure of the structural glazing sealant and that all glass, spacers and system components have been properly installed.

Structural sealant glazing systems, like any glass installation should be inspected on a regular basis to substantiate that damage has not occurred that would affect its structural integrity.

Key personnel indicating relevant job experience:

The successful contractor has to provide the Architects within two weeks of signing this contract, the detailed resume indicting the relevant experience and qualification details of all technical people who would be involved in this project.

Guarantee and life expectancy periods of key materials and components:

Sl. No.	Item	Guarantee Period (Years)	Life expectancy Period (Years/ Cycles)
1	Glass units	10 years	30-40 years
2	Insulating Glass units within Cavity Electric – Operation Blinds	N/A	N/A N/A
3	Gaskets (Type: Extruded Silicone) (Type: EPDM)	10 years	30-40 years
4	Anodized surface finishing	10 years	N/A
5	Galvanized surface finish (Type: Hot Dipped Zinc)	10 years	30-40 years
6	Sealants (Type: Dow Corning Silicone)	10 years	30-40 years
7	Insulation (Type: Mineral Wool)	10 years	50 years
8	Membranes and Vapour barriers (Type: Various)	-	30-40 years
9	Bracketry and sub-construction	10 years	30-40 years

**33. STRUCTURAL GLAZING SYSTEM**

The method of assembly, reinforcing and anchorage of the metal wall cladding / structural glazing system, wherever indicated, is schematic. Locations and method of providing it shall be the contractor’s responsibility. He shall design the assembly, reinforcing and anchorage to suit each specified condition in an acceptable manner complying with the requirements specified hereinafter.

Visible joints shall be as shown on the architect’s drawings.

All parts shall be secured by concealed means wherever possible and where exposed to view, screw positions are to be indicated on the preliminary drawings. Exposed screws shall be of the countersunk type coloured in same finish as of aluminium or non-magnetic stainless steel and shall be evenly and neatly located in the approved manner.

All components shall be assembled, secured anchored, reinforced, sealed and made weather tight in a manner not restricting thermal or wind movements of the structural glazing. Where possible, sealants shall be concealed.

All fastenings into or through aluminium sections shall be non-magnetic stainless steel.

Free and noiseless movement of all the components of the structural glazing system due to thermal effect, structural effect, wind pressure, erection or dead loads, shall be achieved without strain to glass, without buckling of any component and without excessive stress to any members of assemblies.

Aluminium surfaces in contact with mortar, concrete, plaster, and masonry, wet-application of fireproofing and absorptive materials shall be coated with an anti-galvanic, moisture-barrier material.

#### 34. **MULLIONS AND TRANSOMS**

The sections of mullions and transoms shall be designed to withstand deflection and wind pressure and shall be rigid enough to support and retain the glass spandrel under all conditions. The mullions shall be designed to act as guide tracks for gondolas to permit its free movement in vertical direction for window washing and to sustain concentrated loadings by the gondola cage.

Reinforcing members, where used, shall be completely enclosed and if fabricated from steel shall be galvanized and protected with two coats of zinc chromate, where welded shall be treated in the same way.

#### 35. **WINDOW UNITS (VISION GLASS)**

All fixed windows shall be glazed from inside where possible. All internal cladding as well as internal glazing beads, if any, (unless otherwise shown on the drawings) shall be in aluminium with finish as described in the specification.

#### 36. **SPANDREL**

Spandrel shall be either sandwich aluminium or glass panel as indicated in the drawing.

Structural spandrel beam, structural glazing fasteners and other constructions shall not be seen through the glass from the exterior and shall be fully concealed within the metal spandrel.

Two hours rating fire stops shall be constructed continuously at the spandrel.

#### 37. **VENTILATORS, OPENABLE WINDOWS AND DOORS**

Ventilators and doors shall be provided at position as shown on the drawings. The ventilators when in closed position shall remain watertight under all weather conditions and pass the watertightness tests as described in the specification.

All hardware and accessories shall be supplied by the contractor and when exposed shall be of stainless steel or coloured to match structural glazing finish where possible.

The tenderers keeping the position as shown on the drawings must propose the detailed system of the ventilators and doors.

**38. COPING AND SOFFIT TRIMMER**

The contractor shall perform installation of coping and soffit panels and field sealing between the copings and other trades.

All coping and soffit panels shall receive steel frame reinforcement and be fixed rigidly to the structure.

All joints between coping/soffit panels to structural glazing frame and other sections of the work shall be tightly sealed up. Effective drainage system shall be provided to drain out the water that may penetrate through the joints.

**39. LOUVERED PANELS (VENTS)**

Louvered panels shall be acoustic sealed type and shall be provided at positions as shown on the drawings.

Louvers shall be of approved aluminium weatherproof with an assumed efficiency of 40% and be complete with stainless steel bird proof stainless steel wire mesh fixed internally.

All hardware and accessories shall be, when exposed, of non-magnetic stainless steel and / or coloured aluminium to match that of the structural glazing / cladding where possible.

**40. WORKMANSHIP**

All work shall be performed by skilled workmen, specially trained and experienced in the applicable trades and employed and in full conformity with the applicable provisions of the listed references and standards and / or otherwise noted on the drawings or as specified herein.

All work shall be carefully fabricated and assembled with proper and approved provisions for thermal expansion and contraction, fabrication and installation tolerances and design criteria.

All forming and welding operations shall be done prior to finishing unless otherwise noted.

All work shall be true to detail with sharp, clean profiles, straight and free from defects, dents, marks, indentations, waves or flaws of any nature impairing strength or appearances; fitted with proper joints and intersections and with specified finishes.

All work shall be erected plumb, level, square to line, securely anchored, in proper alignment and relationship to work of other trades, and free from waves, sags or other defects.

Where two or more sections or metals are used in building up members, the surface in contact shall be brought to a smooth, true and even surface and secured together so that the joints shall be absolutely tight without the use of any pointing materials. Exposed sealants except where shown will not be permitted. Extrusions shall be tolerated to eliminate any edge projection or misalignment at joints.

Furnish physical samples of all joinery elements as per comparative appraisal and approval of all production materials. Physical samples of all typical wall intersection assemblies shall be colour coded on surfaces and / or areas to receive sealants.

#### 41. **PROTECTION OF METALS**

Protection against galvanic action shall be provided wherever dissimilar metals are in contact.

Aluminium, which is to be in contact with, cured concrete, mortar or plaster shall have the contact surfaces protected wherever crevices between the contact surfaces may entrap moisture and corrosive elements. Where appearance is a factor, all metals, except galvanized or stainless steel, which are to be in contact with fresh concrete, mortar or plaster, shall have the contact surfaces protected with bituminous paint.

Furnish a schedule of all protective coatings and related items including the designation of area and / or specific loadings, materials used, special instructions, specification data sheets, etc.

#### 42. **WELDING**

All welding in aluminium work shall be done by the inert gas shielded arc or flux less resistant techniques, and with electrodes and / or by methods recommended by the suppliers of the metals being welded. Type, size and spacing of welds, shall be as shown on approved shop drawings.

Welds in galvanized metal shall be touch up with zinc rich paint.

Welds behind finished aluminium surfaces shall be so done as to eliminate distortion and / or discolouration on the finished side. Weld spatter and welding oxides on finished surfaces shall be removed by de-scaling and / or grinding. Provide low heat fillet welds using chill bar on finished side to eliminate dimpling, distortion and / or discolouration on the finished or exposed surface. Plug, puddle or spot welding is not permitted. If weld

beads are shown on exposed finished surfaces, the surfaces shall be ground and polished to match and blend with finish on adjacent parent metal.

Structural welds shall be made by certified welders and shall conform to the general recommendations and regulations of Bureau of Indian Standards.

Vapour degreasing or suitable solvent shall be used to remove dirt, grease, lubricant, or other organic material.

Joints rejected because of welding defects may be repaired only by re-welding. Defective welds shall be removed by chipping or machining. Flame cutting shall not be used.

Where welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter, or tramp metal.

All welds shall be scheduled and designed on the shop drawings so that anyone can witness and assess the assembled units to ensure that all welds conform to the designated and approved type, size, spacing, etc.

All welding shall be done by skilled mechanics qualified or licensed in accordance with local building regulations. Welds and adjoining burnt areas in prime coated surfaces shall be thoroughly cleaned and painted with one coat of primer. Welds in galvanized steel shall be coated with one coat of zinc rich paint. Special care shall be taken to protect glass and other finished surfaces from damage and to prevent causing fires.

#### 43. **SOLDERING**

All soldering and / or brazing shall be done as recommended by the suppliers of the metals involved.

#### 44. **SHOP PAINTING OF CARBON STEEL**

Items of carbon steel, unless galvanized or scheduled for other finish, shall be thoroughly cleaned or all loose scale, filings, dirt and other foreign matter and shall be painted with zinc chromate primer.

#### 45. **PERFORMANCE TESTING**

##### GENERAL

The contractor shall supply copies of shop drawings and calculations to the architect and the test laboratory prior to installation of the test units. These drawings shall include:

- Test elevation and sections;
- Full-scale typical details of mullions, transoms and panels (including intersections of members);
- Typical support details;
- Extent of sealants;

- Size and number of pressure equalization / drainage slots or holes;
- Blanking off details and
- Method of installation;

Any deviations from the drawings shall be recorded and noted in the final report.

After approval of structural calculations and shop drawings for the structural glazing test units for performance testing of the structural glazing shall be constructed by the contractor at the testing laboratory.

#### 46. TEST UNITS

The test units shall comprise components representative both in size and shape of the façade of the building under examination. The width of the test sample shall be not less than that of three typical adjoining wall panels / units. The height of the test sample shall not be less than 2 storeys high and must contain full-height modules of the walling system. Spandrel panels shall be included above and below the glazed (vision) area (s). Vertical and horizontal movement joints shall be included in the test sample.

Where details of the building façade differ from those in the representative test sample, such as at corners, overhangs and the like, supplementary tests shall be performed on either composite or part sample of the façade.

The materials of the test sample (glass, aluminium, reinforced concrete, sealants, gaskets, etc.,) shall be of the sample, type and size and have the same details, methods of construction, flashing and anchorage as the building façade.

If not an actual on-site representative sample of the wall of the building, the test sample shall be mounted and sealed into a simulated building frame in the same manner and by the same fixings which are intended to attach the façade to the building structure. The support frame shall be of equivalent stiffness to that supporting the building to prevent unrealistic deflections of the prototype sample.

Simulated floor slabs and spandrel shall be to actual depth if, for example in structural glazing the air seal is connected to the slab. The internal finishes and linings shall be installed where they contribute to the air seal of the façade. The air seal of the test sample shall be continued to the air seal of the test chamber.

All mullions, transoms and other interconnected joints in the façade shall be sealed at the sample boundaries. This is to minimize the effects that the surrounding construction will have on the test performance of the sample. All pressure equalization and drainage slots or holes in the test sample shall be left open.

Transparent viewing panels (or other means of observation such as an optical fibre probe) shall be provided so that the performance of the façade in areas that are not readily seen can be determined.

#### 47. INSTALLATION

### Quality control

#### 47.1 Qualification of workmen

All work shall be performed by skilled workmen, especially trained and experienced in the applicable trades employed and in full conformity with applicable provisions of the listed references and standards and / or as otherwise noted on the architect's drawings or as specified herein. The qualifications of the contractor's installation workmen shall first be filled with and approved by the architect.

#### 47.2 Setting out

Benchmarks for elevations and building line offset marks for alignment shall be established on each floor level by the contractor, who shall be responsible for their accuracy. Should any error be found in their location, the contractor shall notify the architect in writing and installation work shall not proceed in the affected area until the errors have been corrected.

Within 2 weeks upon the award of the structural glazing contract, the contractor is to submit the structural glazing anchorage plan for endorsement and approval by the professional engineer. Within 2 weeks upon the approval of the anchorage plan, the contractor is to deliver to site the bracket / anchors for installation and casting together with the RC floor slab as per approved anchorage plan and according to contractor's construction schedule.

#### 47.3 Prior inspection of the structure

After the setting-out has been established and before beginning installation in any area, the contractor shall examine all parts of the structure on which the structural glazing system / metal wall cladding are to be placed in that area. Should any conditions be found which, in his opinion, will prevent the proper execution of his work or endanger its permanency, he shall report such conditions in writing to the architect. Installation work are corrected or adjusted to the satisfaction of the architect and the contractor.

#### 47.4 Workmanship

All parts of the metal wall cladding / structural glazing system shall be erected plumb and true in proper alignment and relation to established setting-out, as shown on approved shop drawings.

#### 48. **ERECTION TOLERANCES**

The installed metal wall cladding / structural glazing system components shall conform to the following erection tolerances:

Amount of total deviation and / or misalignment in any direction for vertical members: 3mm maximum in a height of 4m and maximum 7mm in a 14m run.

Amount of total deviation and / or misalignment in any direction for horizontal members: 3mm maximum in a 7m run.

Maximum offset from true alignment between two abutting members shall be 1 mm. No edge projection or misalignment will be permitted.

Maximum joints, gaps or openings between removable glazing stop and adjacent member shall be 1mm and / or a maximum 1mm cumulative opening at both ends of removable members (0.5mm each end).

Allowances for the cumulative effect of all tolerances (fabrication, assembly, thermal and erection) must be made to ensure a workmanlike installation. The documentation and distribution of this information to all applicable installation and inspection personnel is essential in order to ensure the standard or quality and workmanship required.

Installation within and / or adjacent to concrete:

Where work is to be installed within and / or adjacent to concrete, no structural glazing system / metal wall cladding components other than built-in anchor devices shall be put in place until the concrete work is completed, including the removal of all forms, shoring, etc.

#### 49. ANCHORAGE

Anchorage of the metal wall cladding/structural glazing system to the structure shall be by approved methods and in strict accordance with approved shop drawings. After the metal wall cladding/structural glazing systems are properly positioned, all connections so designated on approved shop drawings shall be rigidly fixed by welding or other positive means.

All anchorage assemblies and their related components shall be thoroughly scheduled and described on the shop drawings so that anyone can evaluate an installation and ensure its compliance with the contract documents. Designate trades responsible for furnishing and / or installing materials if other than the contractor. Descriptive items shall include the access removal movement and tolerances of related building and metal wall cladding / structural glazing system components, direction and magnitude of thermal expansion, materials, sizes, quantities and any special instruction as may be required. All primary metal wall cladding/structural glazing anchorage assemblies inclusive of skylight space frame/structural mullion shall receive a 100% inspection.

#### 50. USE OF SEALING MATERIALS

Sealing materials shall be used in strict accordance with the manufacturer's printed instructions and shall be applied only by workman specially trained or experienced in their use. Before applying sealant, all mortar, dirt, dust, moisture and other foreign matter shall be completely removed from surfaces in contact. Adjoining surfaces shall be masked



when required to maintain a clean and neat appearance. Sealing compounds shall be tooled to fill the joint and provide a smooth finished surface.

The manufacturer(s) of the applicable materials shall, when required, render technical assistance prior to the application of any sealant and witness the first applications as well as periodic site inspections thereafter. The contractor shall witness and document all inspections performed by the sealant manufacturer and provide close supervision of all workmen used to apply the sealants.

**51. SEQUENCE OF INSTALLATION**

If so directed by the contractor, installation of the metal wall cladding / structural glazing panels and / or glazing shall be postponed in areas as designated by the contractor for a specified period of time so as to facilitate moving materials / equipment into and out of the building and installation of M & E fittings during construction. The Contractor's work is to proceed along guidelines and schedule as directed by the engineer in charge.

**52. LIGHTNING PROTECTION**

The whole of the structural glazing when having insufficient clearance from the lightning protection system shall be bonded as directly as possible to the lightning protection system. Provision shall be made at the top most level and the second storey level for eight (8) points each, equally spaced around the structural glazing perimeter for bonding by the electrical contractor. The exact locations of the bonding points shall be as determined by the architect. The contractor shall incorporate lightning protection device and install all inspection openings for test lamps, etc., for the whole metal wall cladding / structural glazing system.

**53. FIRE-STOP**

Joints at structural glazing between storeys shall have the required fire resistance of 2 hours, or as in accordance with local fire codes. Endorsement of such provision in compliance with the above requirements on plans as and when required by the authorities.

**54. MATERIALS GENERALLY**

Materials and components used shall be of the best quality and suitable for the purpose and as approved by the architect.

Aluminium panels shall be of minimum thickness of 3mm.

All materials shall be free from any defect that may impair the strength, functioning or appearance of the cladding wall or adjacent construction.

**55. METALS**

In general, metals shall be of the quality defined in the following listed standards, or any other equivalent standards provided they conform to the chemical, mechanical, test and other control requirements prescribed by the appropriate listed standards. Thickness and tempers of aluminium alloy products shall be shown on the shop drawings, and / or as required for forming and finishing operations and structural requirements.

## ALUMINIUM

Extrusions: shall conform to equivalent Indian standards.

Sheet / plate: shall conform to equivalent Indian standards.

### .1 a) Carbon steel

- Rolled shapes, plates and bars: shall conform to ASTM A36-70a.
- Cold rolled sheets, stretcher leveled shall conform to ASTM A-366.

### b) Stainless steel

- No.8 mirror polished finish to BS 1449 with a minimum sheet thickness 1.5mm to 2.0mm to Manufacturers recommendation.
- Rolled shapes, plates and bars: shall conform to ASTM A242-70a.
- Cold rolled sheet and strip: shall conform to ASTM A607-70.
- Hot rolled sheet and strip: shall conform to ASTM A607-70.

### c) Mild Steel

- Angles and tees: to BS 4840: Part 4
- Hot rolled from steel to BS 4360
- Bars: to BS 4360

### .2 Metal wall cladding

All clad elements shall be fabricated with minimum 4mm thick aluminium composite panel of colour and shade specified by the architect comprising thermoplastic resin core sandwiched between two skins of aluminium alloy.

Samples and manufacturers specification shall be submitted along with the tender for evaluation.

### .3 Fasteners:

The type, size, alloy, quantity and spacing of all fasteners and / or anchorage devices shall be as required for the specified performance standards.

- a) Bolts, anchors and other fastening devices shall be of approved types as required for the strength of the connections, shall be self-locking, unless conditions encountered, and shall be torque tightened, where required, to achieve the maximum torque tension relationship in the fasteners. Washer, nuts and all necessary items shall be of the same material as fasteners.
  - b) Fastening devices between aluminium and aluminium shall be AISC Type 302 (18-8) stainless steel only.
  - c) Fastening devices between aluminium and dissimilar materials shall be 300 series non-magnetic stainless steel only.
  - d) Exposed fasteners are subject to Architect's approval and shall be stainless steel and shall be finished to match applicable aluminium finish.
  - e) Self-locking fasteners shall be stainless steel with nylon inserts or patches.
  - f) Welded studs shall be stainless steel for steel substrate material and aluminium studs for aluminium substrate material in alloys and sizes as required.
- .4 Extruded aluminium sleeves: All surfaces abutting the parent sections and designed to receive sealant shall be extruded with serrated surfaces to augment sealant contact and adhesion. Finish to match parent section.
- .5 Stainless steel flashings:
- .6 Copings: All coping panels shall be of similar metal and same finish as the cladding wall panels.
- .7 Soffits: Soffits and suspended ceiling system shall be of similar metal of the metal wall cladding and organic coating finish. Colour and shape to be selected by the Architect.
- .8 Fire stop between storeys shall be provided 2 hours resistance or as in accordance with the local fire code.
- .9 Structural steel support for skylight – designed either for space frame or structural mullion, thickness and sizes according to manufacturer's design subject to Architect / Engineer's approval.
- .10 Protection: Material used as permanent or temporary protection shall conform with the standards here listed.
- a) Paint for carbon steel
    - Concealed parts: one shop coat of rust inhibitive primer or zinc chromate primer.
    - Exposed parts: Zinc rich primer
  - b) Galvanizing of Carbon steel

- Shapes, plates bars and strips: ASTM A-123 fasteners hardware: ASTM A-153
- Sheets: ASTM A525
  
- c) Cadmium plating: ASTM A165-81 Type NS
  
- d) Zinc Chromate primer: FS TT-P-645
  
- e) Bituminous paint: FS TT-C494

## 56. GLASS

- .1 All glass and glazing materials shall conform to the applicable performance requirements.
- .2 Furnish and install glass and glazing work as indicated on the drawings and as specified herein. All glass shall be cut to required sizes and ready for glazing. Any pane which does not fit any section of the structural glazing / windows / ventilators will be rejected and a replacement made at the contractor's expense. All glass to be of accurate sizes with clear undamaged edges and surfaces, which are not disfigured.
- .3 Glass shall conform to the quality, thickness and dimensional requirements specified in US federal specifications DD-G0451C OR equivalent Indian standard.
- .4 All window units shall be of single glazed or double glass system as shown on drawings.

The monolithic reflective glass specified herein shall be 6mm thick for single glazing and of type VS 2-14 or VS 2-16 or as specified in the BOQ.

The unit shall have:

- |                                   |      |             |
|-----------------------------------|------|-------------|
| • Visible light Transmittance     | -    | 11%         |
| • Visible light Reflectance (out) | -    | 24%         |
| • Visible light Reflectance (in)  | -38% |             |
| • Solar Transmittance             | -    | 6 – 7%      |
| • Solar Reflectance               | -    | 14 – 15%    |
| • Summer daytime U-Value          | -    | 0.91        |
| • Shading co-efficient            | -    | 0.28 – 0.29 |
- .5 Permanent identification marking on glass shall be accomplished by a technique selected by the manufacturer. The location of the marking shall be proposed by the Manufacturer and approved by the Architect. All glass shall be delivered to site with the Manufacturer's label of identification attached.
  - .6 Submit for Architect's approval a complete list of materials to be used, including the sealants proposed and such samples as the Architect may require. All glass and glazing methods and materials including the design and profile dimensions of glazing pockets shall

be as approved and recommended in writing by the applicable glass and sealant manufacturers.

- .7 Factory glaze all glass that is indicated to be adhered to aluminium frame with sealants. Sealants shall be fully cured prior to shipment to project site and installation.
- .8 Glass breakage

All glass breakage caused by the Contractor or his sub-contractor because of negligence or caused by the installation of faulty work by him shall be replaced by the contractor at his own expense without delay to the project completion.
- .9 The contractor shall be responsible to deliver to the Employer without charge replacement for any unit of glass and glazing that fails within the Indemnity period of ten (10) years from date of completion of main contract.
- .10 Glass shall conform to the quality, thickness and dimensional requirements specified in US federal specifications DD-G-451C or Indian equivalent.
- .11 The glass infill panel / structural glazing frames for structural glazing within 900mm high above 2<sup>nd</sup> storey floor, shall be designed to withstand lateral imposed load and comply with requirements of local building codes. Contractor shall submit design calculation to architect before commencement.
- .12 Glass thickness should be selected in accordance with AS 1288 – “SAA Glass Installation Code” or Indian Equivalent to satisfy design performance requirements and local design codes.

Glass shall be free from defects or impurities detrimental to its performance. Defects which are not detrimental to the performance such as bubbles, waves, spots, scratches, spalls, discolouration, chipping or impurities shall only be acceptable if not visible from a distance of 3m or more, or in accordance with the Manufacturer’s guidelines. The glass is to be produced in such a way that the rollers will be parallel to what will be the horizontal position of the glass. Glass shall be consistent in colour.

#### 57. **IN-PLANT AND JOB SITE INSPECTION**

The contractor shall afford the architect, employer and / or their authorized agent full access to plants, shops and assembly points to view and inspect the processes and methods employed in the fabrication, assembly and finishing of the metal wall cladding/structural glazing system for this project.

#### **INSPECTION OF TEST UNITS (OPTIONAL)**

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The contractor shall allow for the architect or his representative to inspect the test sample regularly during erection. At this stage the adequacy and stiffness of the support structure shall be assessed. When the installation of the test sample is complete, the architect or his representative shall inspect the test sample and, if satisfied, shall approve its completeness.

Testing shall not commence until this approval has been given.

Full time attendance by approved representatives of the contractor shall be provided for the erection of the test unit and all testing of the test unit.

### TEST REQUIREMENTS

#### TEST OF WIND PRESSURE

**METHOD** : The equivalent load for wind pressure or wind suction shall be given to the test unit as increasing and decreasing the inside pressure of the “pressure chamber” at which the test unit is fixed.

**STATIC WIND PRESSURE** : The static pressure shall be increased to a maximum of  $\pm 135$  kg/sqm in steps.

**DYNAMIC WIND PRESSURE** : The variation of dynamic pressure shall be approximately sinusoidal with each cycle having a period of 2 seconds.

**OBSERVATION** Deflection on each observational point of the test unit shall be observed and recorded under the static pressure as described above.

**EVALUATION** No damage or harmful permanent deformation on any parts shall be found at the maximum design wind pressure as defined. The deflection of the main structural members in this condition shall be less than  $L / 250$  (L=length between support) or less than 20mm whichever is least. No damage or harmful permanent deformation of any parts shall be found at the maximum testing pressure. The maximum deflection / span ratio of glass shall not exceed 1:90.

The success residual displacement of a member shall not exceed at supports and fixing shall not exceed 1.0mm.

#### **TEST OF WATER TIGHTNESS (STATIC PRESSURE)**

**METHOD** :Water shall be sprinkled on the test unit under the same condition as under test on static wind pressure as described above. Pressure shall be maintained continuously for 10 minutes and the pressure of every  $\pm 50$  kg/sqm and +150 kg/sqm at maximum. The volume of the sprinkling water in one minute shall be 5 liters/sqm.

**OBSERVATION**

All water leakage and drainage system at the joints and ventilators of the structural glazing system shall be observed from the inside of the chamber. Hold the test 3 times, in sequence as described below, conforming to the above-mentioned conditions:

Install the test unit.  
Hold first water tightness test.  
Hold test on wind pressure as described above.  
Hold second water tightness test.  
Cut the compound type sealant if any on purpose.  
Hold third water tightness test.

**EVALUATION**

Water leakage at all parts of the test unit should not be observed inside during the first water tightness test except for ventilator, where water leakage should not be observed at the pressure of 100 kg/sqm.

If water leakage and splash are observed on the ventilator they should be provided with a proper drainage system.

In case water leakage is observed during the third water tightness test, effective drainage system should be provided.

**TEST OF WATER TIGHTNESS (CYCLE PRESSURE)**

**METHOD**

This test shall be performed upon completion of the test for water penetration by static pressure.

Should the cyclic water penetration test not commence within thirty (30) minutes of the static water penetration test, then, immediately prior to the start of the cyclic test the exterior face of the test sample shall be completely sprayed with water at a rate not less than 0.05L / sq m for five (5) minutes with zero air pressure differential on the façade.

Water shall be applied to completely and continuously cover the exterior face of the test sample at a rate not less than 0.05 L / sq m while a cyclinc positive air pressure is applied to the exterior face for a period of not less than five (5) minutes. The applied positive pressure shall be varied between the specified limits with a cycle time of three (3) to five (5) seconds.This procedure shall be repeated for each of the steps shown below:

STEP	MINIMUM	MAXIMUM
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1	30 KG/SQM	60 KG/SQM
2	30% positive permissible stress design pressure	60% positive permissible stress design pressure

The air pressure differential shall be reduced to zero for two (2) minutes between each step with the water spray still in operation.

**OBSERVATION** Observation of the internal face of the façade shall be carried out during the water spray operation and for five minutes after the water spray has stopped and there is zero air pressure differentials on the facade.

Any water appearing on the inside face of the facade shall be recorded, with the extent and, if possible, the source of leakage indicated.

**EVALUATION** There shall be no leaks at 60% of maximum positive pressure. A leak is considered to occur when:

Water appears on the inside face of the facade is visible from an occupied space; or,

Uncontrolled water appears on the inside face of the façade is likely to damage insulation or other architectural fixtures. Uncontrolled water is defined as any leakage that is not contained and drained away within the test duration (including the five minutes observation period).

**AIR INFILTRATION TEST**

**METHOD** The face of the test sample shall be sealed airtight by covering it with an impervious film. If this is not practicable, all joints, weep holes, and glazing or sealant lines of the test façade shall be sealed with impervious adhesive tape. Positive and negative test pressures of 7.5 kg / sq m shall be applied and the base air infiltration rates through the test apparatus determined by a calibrated flow - metre inserted in the air pressure line. The sealing film or tape shall be removed from the test sample and the total air infiltration rates determined. The air infiltration through the test sample shall be the difference between the base and total readings.

**EVALUATION** : Air infiltration shall not exceed 1.0 L / sq m or such



lesser value as may be determined by the architect on advice from the air conditioning system designer.

## PROOF TEST

### METHOD

The test sample shall be subjected to proof tests. The applied positive and negative pressures shall be 1.5 times the positive and negative permissible stress design pressure as determined from AS 1170-1983 Part 2. Each proof test pressure shall be maintained on the test sample for a period of one minute.

Dislodgment of any glass.

Dislodgment of any frame, panel or any thereof

Failure of any fixings that connect the façade to the building structure, such that the test sample is unstable.

Failure of any stop, locking device, fastener or support which would allow an opening light to come in.

### FORM OF REPORT

Details of the test sample (including an outline of the simulated building frame) and the test apparatus, instrumentation and method shall be clearly given in a report.

The report shall include the following:

An identification and general description of the façade and certificate of identity from the builder or his nominated contractor.

Drawings of the actual test sample showing modifications, if any.

Test sequence with pressure used in all tests.

Locations of all transducers for the structural performance test.

Displacements, span/deflection ratios and air infiltration rates.

Other pertinent observations.

### **RECORD DRAWINGS**

The testing laboratory shall keep copy of approved test unit shop drawings and calculation at testing laboratory shall accurately and neatly record on the above mentioned shop drawings all changes, revisions, modifications, etc., made to test unit, which shall become the record drawings.

At completion of testing and after approval of test reports the testing laboratory shall submit the marked-up record drawings to the architect.

#### **COST OF PERFORMANCE TESTING**

The testing laboratory shall provide the test chamber and support structure for the test unit. The contractor shall allow in his tender for the cost of the fabrication, erection, corrections to and the demolition of the test unit. The contractor shall fabricate, erect, correct and demolish the test unit. If the test unit fails to pass the initial testing, the contractor shall make the necessary corrections to the test unit and shall have the test unit re-tested by the testing laboratory until it passes the test. Cost of corrections to the test unit and cost of retesting shall be paid for by the contractor at no additional cost to the employer.

The contractor will have 3 months after the award of tender or as directed by the architect to set up the test unit and carry out all the required tests as described. The contract will be signed only if the testing results are satisfactory. Upon expiry of the said testing period, if the testing results still fail to meet the required standard, then the awarded tender will automatically be cancelled.

#### **WIND TUNNEL TEST (OPTIONAL)**

The architect may instruct the successful tenderer to do the wind tunnel test based on the following scope of works,

##### **WIND CLIMATE**

Re-process wind data for Bangalore using information from meteorological department of Bangalore to establish the mean 50 years geotropic design wind speed and direction. A separate database for daylight hours and thunderstorm activity removed is to be used for environmental wind climate studies.

##### **MODEL**

The test shall employ specific building model centered in a turn table, which reproduces the local topography, terrain contours and buildings on a scaled diameter of 1 km around the development. Scale of 1:400 shall be used to ensure adequate simulation of the turbulence characteristics of the scaled wind.

Information to be provided by the architect for building the model will include only the architecture floor plans, elevation and location plans of this development. Information on adjacent building for the construction of the proximity model will have to be gathered by the test laboratory.

The model shall be a rigid pressure tapped model (1:400 scale) and shall be constructed to allow direct measurements of the design cladding pressures. The number of pressure taps used shall not be less than 300 taps.

##### **REPORTING**

Two copies of report shall be submitted on conclusion of the study. This report shall compile the results of all of the investigation work.

The report shall also contain the following:

Peak positive, peak negative and mean pressure at each tap point. Data to be in Pascal or N / sq mm.

Peak positive pressure contours in Pascal or N / sq mm.

Peak negative pressure contours in in Pascal or N / sq mm.

Photographs of the building model and proximity model.

## **WIND TUNNEL**

The tests shall be carried out in a wind tunnel with the test section dimensions not less than 3m x 2m (width x ht.). The tests shall be carried out for 24 wind directions.

### TIMING

The wind tunnel test should be completed within four weeks after the letter of award and the wind tunnel test report to be submitted within one week after that

## **10.00 TECHNICAL SPECIFICATION FOR ALUMINIUM SECTIONS / GLASS FOR JOINERY WORKS**

### **GENERAL:**

This specification covers the general requirements for aluminium doors, windows and ventilators manufactured from extruded aluminium alloy sections of standard sizes and designs complete with fittings including supply, fabrication and installation in accordance with the drawings and specifications.

The supply, fabrication and erection will include all parts such as but not restricted to frames, tracks, guides, mullions, styles, rails, couplers, transoms, plates, glazing bars, weather bars, glass, hinges, handles, stays, bolts, locks, latches, locking arrangements, spring catches, cord and pulley arrangements, door closers, floor springs etc., required for the whole work whether the parts / items are individually and specifically referred to in the schedule / specifications / drawings or not, provided that the supply and

installation of such parts can be inferred there from and are necessary to make the work complete, unless separate provision is made in the bills of quantities for supply to such parts / items.

Materials:

a) Aluminium Sections:

- i. The members shall be made out of aluminium alloy corresponding to IS 733 (latest) and will consist of extruded sections and of other shapes, and to sizes and gauges as shown in the drawings / described in accordance with the relevant IS Codes. The members shall be so chosen to provide strength / stability to withstand wind forces, dead & live loads and maximum resistance to wear and tear.
- ii. The sections shall be of approved make extruded sections. The sizes and sections if mentioned in the drawings are only indicative and schematic and should be considered only as aesthetic requirement. The contractors should specifically mention which sections he is proposing to use and shall submit sufficient proof in writing the adequacy of the sections for the purpose it is intended to be used.
- iii. The IS specifications are to be strictly adhered to. Samples of sizes as mentioned in the curtain glazing section of this document shall be submitted and only after approval of sample in writing by the architects fabrication work can be taken up.
- iv. The various tests of aluminium section shall be conducted in accordance with relevant IS Codes.

3. Finishing:

- i. The extruded aluminium section shall be mechanically finished to remove all scratches, extrusion marks, dust, scales etc and subsequently thoroughly cleaned in an alkali bath prior to anodizing.
- ii. Anodizing shall strictly conform to the provisions of IS 1868.
- iii. The anodizing shall be in natural finish by electro chemical process as per IS Specification 7088 (latest) and thickness shall be 15 microns. Film thickness test for anodic coating shall be done in authorized test house and test results shall be submitted to the Engineer.
- iv. The anodized material shall be protected properly by adhesive tape wrapped completely before fabrication to avoid scratches during fabrication and erection and shall be kept protected till handing over.

4. Submittals:

The contractor shall submit detailed fabrication drawing with supporting calculations. The drawings should be in detail and indicate clearly section sizes, method of joints, erection procedure, fastenings, glazing and its fastening methods, sealants to make the door weather proof and airtight. Any procurement / fabrication work shall commence only after the shop drawings are approved by the architects / consultants.

5. Fabrication:

Before fabrication the contractor shall verify the door , window , ventilator and partitions sizes in the drawing with the corresponding finished openings left at site where the doors, windows, ventilators, partitions are to be fixed. J

Fabrication shall be taken up only on approval of and in accordance with the approved drawings. Should there be any necessity, the Engineer may revise the sections of any door/ window / ventilator etc. and the same shall be followed for execution. However the rate quoted for the relevant finished item shall be adjusted only for the difference in weight of Aluminium sections in KG between that specified by the tender at the time of tendering and that modified by the Engineer. All other elements of cost variation due to such modifications in the sections shall be deemed to have been included in the quoted rates.

Fabrication shall be done true to the drawings to correspond to the finished openings at the site, the sections cut to lengths to suit, mitered at the corners, to true right angles with joints made neatly to hair lines, with concealed fasteners, wherever possible joints shall be made in concealed locations.

All fabricated items shall be packed and crated properly before despatch to site to prevent damage in transit. On receipt at site they shall be carefully stacked and protected, stored in a manner to avoid distortion / damage.

6. Construction:

The units shall be factory built wherever possible to precision, alignment, dimensional accuracy and strength.

The frames shall be fitted together by mechanical means using best fabrication techniques and appropriate tools.

The interlocking members shall be accurately manufactured to close tolerances to ensure tight fit of the mating interlock profiles.

There shall be minimum gap between shutter and frame to facilitate easy and smooth movement of the shutter.

Field connections may be made with concealed screws, self-tapping or other approved fasteners or with weld. Due precautions shall be taken to avoid altogether distortion / discoloration of the finish.

Details of construction of the doors, windows, ventilators partitions shall be as specified in the relevant I.S codes and in the absence of such details in any I.S. code, will correspond to the best engineering practice.

Faces / Parts in contact with masonry in the construction shall before shipment to the site be given a heavy coat of an alkali resistance bitumen paint. Aluminium members in contact with other incompatible metals shall be treated as mentioned for members in the structural glazing section of this document.

The sliding shutters are to be fixed with nylon rollers with stainless steel ball bearings and stainless steel pin.

The doors, windows, ventilators and partitions shall be supplied in natural colour (matt finish) / anodized to approved shade as per drawing / item specifications. Anodizing shall be matt finish under electrically controlled conditions conforming to IS 6057, and to be minimum thickness as may be specified in the item specifications or if not so specified to a minimum thickness of 25 microns excepting on the fittings, hinges and such other moving parts where it shall be to a minimum thickness of 20 microns. Any frames found short of microns film thickness of anodizing shall be rejected.

For installation the supplier on the aluminium doors, windows ventilators and partitions to protect the surface shall apply a thick layer of clear transparent lacquer based or methacrylates or cellulose butyrate. The coating shall be removed after installation is done. They shall be cleaned thoroughly with warm water to restore the finish.

Scaffolding is the responsibility of the contractor and shall be erected without causing any damage to the structure and the finishes therein. MS props and H frames shall only be used for scaffolding.

7. Glazing:

Glazing shall be of flawless sheet glass or as specified in BOQ of best approved quality without waviness, distortion, coloration / discoloration, of specified thickness, in sizes as shown in the drawings, fixed as required with special glazing clips, neoprene / PVC gaskets. The gasket shall be extruded EPDM synthetic rubber wrap around U channel type with beveled edges to run continuously around the perimeter of the glass. All glass shall be cleaned thoroughly before they are fixed in position.

8. Sealing:

Sealing shall be done using a silicon sealant single part gun applied to provide watertight seal between the window and the surrounding construction. The type and other details of sealants shall be as specified for glazing in the structural glazing section of this document.

9. Protection and Cleaning:

The Contractor shall be responsible for the protection of all aluminium works during the course of construction of the building and for cleaning all aluminium works after painting and finishing of building is completed.

The aluminium manufacturers shall give specific performance guarantee against defects in materials or workmanship for a period of ten year from the date of installation.

10. Tests and acceptance:

All tests on samples and final finished work for water and air tightness, smooth movements, coating and all complete shall be carried out as described in the structural glazing section of this document.

In general all other specification wherever applicable as described in the structural glazing section of this document shall be considered while pricing the items.

The rates quoted shall include:

- a) Providing all aluminium doors, windows, ventilators, glazing, railings etc. of the best manufacture and as per prior approval of the Engineer.
- b) Providing necessary couplings, transoms and mullions.
- c) Providing a protective thick layer of clear transparent lacquer based on methacrylates or cellulose butyrate, for protection of surfaces of various units during transportation and installation and removal of the same after installation is complete.
- d) Each shutter of sliding window shall have 2 Nos. Nylon sleeved rollers. Lock and handle shall be provided in Nylon / PVC / Aluminium samples of which shall be approved by the architects prior to fabrication & erection.
- e) Sealing the junction of windows or glazing frame with openings around with epoxy resin or other approved sealant to make the junction watertight.
- f) Fixing of aluminium units in the openings with lugs 15 mm x 3.15 mm x 100 mm long in cement concrete blocks of 150 mm x 150 mm x 150 mm size 1:3:6 (1 cement: 3 coarse Sand:6 Hard stone aggregate 20 mm nominal size) or with wooden plugs and screws or with rawl plugs and screws or with bolts and nuts as required.
- g) Door shutters shall have heavy duty double action hydraulic floor springs pivoted top and bottom with a minimum of ten-year guarantee or as specified in drawing / bill of quantities.
- h) Necessary locking arrangements of approved design shall be provided to door shutters including flush type tower bolts for each shutter as directed.

- i) The Contractor shall furnish detailed fabrication drawings to suit site installation for approval before taking up the work.

Providing single row continuous, neoprene or PVC weather strip to prevent air infiltration to openable shutters.

- j) Hoisting and working at any height including required scaffolding etc., and protecting the aluminium sections and glass from any damage, scratches etc., till being taken over by the Engineer. Rate shall include final cleaning of all items to the Engineer Satisfaction before final handing over.

- k) The manufacture of the aluminium framed glazed doors & windows etc., shall conform to current Indian Standard.

- l) Aluminium Sections shall be of standard extrusion and shall conform to IS 733. and shall be in accordance with the Engineer's drawing.

- m) All Aluminium Sections shall be finished in natural colour electro chemical anodized to 15 microns and a piece of anodized materials shall be got approved before fabrication.

- n) All doors, windows, etc., shall be factory finished and the frame joints shall be absolutely watertight. All frames and shutters shall be properly jointed ensuring adequate mechanical strength and absolute right angle corners.

- o) All doors shall be provided with Bronze finish anodized aluminium push plates or as specified in the drawing / bill of quantity.

- p) The glasses for doors, windows fixed glazing shall be fixed with aluminium anodized finish snap on glazing chips and gasket rubber. PVC weather strip shall be provided.

- q) Matching Sections shall be perfectly aligned for compactness.

- r) Samples of Sections for outer frame, shutter frame, hardware etc., shall be produced for prior approval.

- s) The size and details of doors etc., shall generally be as per the drawings prepared by the Engineer. The Contractor shall take exact site measurements, for all the items before fabrication to avoid any discrepancies.

- t) The rates quoted shall be for supply, delivery and erection etc., complete including packing and all other incidental charges.

Detailed fabrication drawings shall be furnished to suit the site installation for approval before taking up the work.

MODE OF MEASUREMENT:



The method of measurement for various items in the tender shall be generally in accordance with the IS: 1200.

## **11.00 FALSE CEILING WORKS**

### **01. GENERAL**

Suspended ceilings shall be of following types:

- Rockwool Decor Pattern Ceiling
- Incombustible Plaster Decorative Ceiling
- Mineral fibre tiles ceiling
- Plain/Perforated steel/aluminium tiles ceiling

The system namely, design, performance, components, assembly, suspension system, etc. shall conform to BS 8290 - Parts 1&2. The installation shall conform to BS 8290 - Part 3.

### **02. TYPES**

#### **02.1. ROCKWOOL DECOR PATTERN CEILING TILES**

Rockwool Decor pattern ceiling tiles shall be made of hard compressed rockwool, surface treated with granulated white paint. The tiles shall have thermal conductivity of 0.45/pW/m<sup>0</sup>C, reflection of light 89%, fire classification class O and one hour fire resistance, maximum relative humidity 100% and shall retain integrity at temperatures above 1000<sup>0</sup>C without melting.

The size of tiles shall be of 600x600x9mm for exposed grid system and 600x600x12mm for semi recessed grid system and concealed grid system unless otherwise indicated.

The suspension system shall be proprietary manufacture, concealed or semi-recessed or exposed grid as approved by the Engineer.

The suspension system shall consist of primary suspension channels, main runner tee and cross runner tee with perimeter trim all around. The grid system shall be suspended using suspension wire of 1.5mm dia. or by appropriate angles. All exposed components of suspension system shall be compatible with the finish of tiles.

#### **02.2. INCOMBUSTIBLE PLASTER DECORATIVE SUSPENDED CEILING**

This shall be of decorative type comprising of gypsum board background surface on which rosettes, cornices, border moulds and flower designs and similar decorative features are fixed as per the layout given in the drawings. Whenever specified, decorative gypsum tiles/panels of approved size shall be installed.

Plaster sheets, cornices & others shall be made of Gypsum (Plaster of Paris) reinforced with hessian or glass. The sheets shall be vinyl faced wherever indicated. The sheets shall be 15mm thick unless otherwise stated.

The framework shall be either of Red Miranti Wood (Main Members to be of size 75mm x 50mm; cross members to be 50mm x 25mm screwed together with steel screws; the main members to be fixed to the slab with 50mm x 25mm joints with Hilti fasteners; 2 to 3 steel rods suspended from the reinforcement rods of the slab to be provided for additional strength to the frame work) or of proprietary metal suspension system as approved.

Brass screws shall be used for fixing all plaster moulds and sheets to the frame work.

Finishing shall be done at all joints by plaster of paris to give a smooth level.

All surfaces shall be given a coat of eggshell white emulsion prior to application of the colour scheme as approved by the Engineer.

### 02.3. MINERAL FIBRE TILES CEILING

Mineral fibre tiles shall be manufactured from non-combustible mineral fibres bonded by organic materials, formed by felting and heat cured. Sound absorption properties shall be achieved by perforating and/or fissuring the product after curing. The tiles shall have factory applied washable paint on their patterned surface with edges to suit concealed, semi-concealed or exposed grid applications. The size shall be 600 x 600mm unless otherwise indicated.

The suspension system shall be proprietary concealed, semi-concealed or exposed grids as approved by the Engineer.

#### System Performance

- Noise reduction coefficient shall be 0.65 to 0.75 in accordance with ASTM C-423.
- Sound attenuation properties shall be in accordance with ASTM E-413.
- Light reflection factor shall range from 0.71 to 0.80.

## 02. TYPES (CONT'D)

### 02.4. PRESSED STEEL/ALUMINIUM TILES CEILING

#### Material

Steel tiles sheet be made from 0.6mm Zinc coated mild steel pressed and formed to panels/strips and finished with powdered coating of approved colour. Aluminium tiles shall be made from 0.7mm aluminium sheets pressed to form panels/strips, chromated before being stove enamelled with polyester paint.

Acoustic tiles shall be perforated and shall have a suitable in-fill material like rock wool or fibre-glass insulation.

The size of the tiles shall be 600 x 600mm unless otherwise specified.

The suspension system shall be proprietary make and shall comprise of tiles clamped to tee bars fixed at suitable centres to primary channels using GI clips. The channels shall be positioned at no more than 1500mm centres and suspended using proprietary clips and threaded suspension rods.

#### System Performance

- Noise reduction coefficient - Arithmetic average for the normalised level difference over the range of 100-3150 Hz shall be not less than 41dB.
- Light reflection factor shall be not less than 0.80.
- Fire resistance - when tested as per BS 476 contribution to fire-resistance shall be not less than 60 minutes.

### **03. SHOP DRAWINGS CATALOGUES, SAMPLES AND CO-ORDINATION**

The Contractor shall submit for approval all catalogues and samples of the false ceiling completely including suspension system and technical specifications as recommended by the manufacturer of the particular false ceiling specified, prior to ordering.

The Contractor shall also study the installation of the false ceiling in co-ordination with the various trades and particularly electrical and mechanical installations. He shall carefully study/co-ordinate the relative disposition of lighting, ducts, AC grills and other fixtures along with their types, locations and special mounting systems and shall ensure symmetry of placement. Additional supports/trims/mountings as necessary, access panels, etc. shall be provided as necessary and directed. It is the responsibility of the Contractor to redo/modify any unacceptable placement of such fixtures when directed by the Engineer.

Shop drawings shall be submitted to the Engineer for approval showing the detail, layout of the false ceiling, location of lighting, access panels, air conditioning grills/outlets, etc. as well as all details of suspension, demountability for servicing and fixing.

### **04. WORKMANSHIP AND FIXING**

Workmanship and fixing of the various suspended/false ceilings shall be in accordance with the shop drawings, approved manufacturers recommendations and technical specifications.

The suspension of tube ceiling will be by means of factory manufactured suspension rods, with proper arrangement for adjusting the system to true level. The type of suspension system shall be approved by the Engineer prior to commencement of work.

The installation shall be done by skilled labour thoroughly experienced with the particular suspended ceiling specified.

The grid for suspension shall be constructed to true level and to produce perfect alignment of the joints, truly parallel to the building lines and completely free from waviness, to the satisfaction of the Engineer.

All work shall be delivered sound and clean. The Contractor shall protect the false ceiling until handing over of the building and shall clean, paint (as required), remove and replace units which are defective, damaged or improperly installed to the satisfaction of the Engineer.

The fixing of flush mounted lighting fixtures, spot lights, air-conditioning grills, etc. in the suspended ceiling shall be done with utmost care and with due regard to good appearance and best practice and to the satisfaction of the Engineer.

Additional supports, stiffeners, etc. shall be provided around lighting fixtures, A.C. grilles, access panels, etc. as required and as directed by the Engineer.

## **05. SUBMITTALS**

The Contractor shall supply the Engineer with duplicate copies of manufacturer's published data, instructions for fixing and assembly and any other relevant information.

### Samples

The Contractor shall provide samples of components and materials to be used in the work.

A mock-up shall be erected of each type of ceiling, including light fittings, diffusers, etc., as described elsewhere. The mock-ups shall comprehensively include the suspension system and shall be approved by the Engineer before the commencement of the work in general.

### Shop Drawings

The Contractor shall submit for approval shop drawings showing all necessary details including trimming for light fittings, grilles, etc., perimeter details, and all suspension and fixing details.

The Contractor shall submit also layout drawings for each type of room or space which has a suspended ceiling of tiles or panels.

Drawings shall be submitted so that they can be cleared by the Engineer as may be required to progress the main works and specialist's work, but in any event not later than 21 working days before the work is put in hand.

The Contractor shall submit manufacturer's certificate to establish that the specified standards of sound absorption/reduction shall be achieved when tested in accordance with BS 2750. This shall be established by field tests also on completion of the works.

Manufacturer's certificate establishing conformity of requirements of Class I surface spread of flames (BS 476 - Part 7) and Class O Fire propagation (BS 476 - Part 6) shall be submitted.

## **12.00 WATER PROOFING**

This specification covers the general requirements for water proofing to under ground structure, machine foundations, pits, water tanks, trenches, roof slab, sunken slab etc.

### **02 ROOF SCREEDS**

#### **1.MATERIALS:**

Aggregates, cement and water required for screed etc., shall comply with the requirements of Section-02.03 Concrete Works. Unless otherwise specified the screed shall be of PCC 1:1.5:3 with 12mm down graded aggregates.

Wherever specified, lightweight concrete from an approved source shall be used for the roof screed and the materials shall conform to the requirements stated elsewhere and laid strictly as per the approved manufacturer's recommendations.

The proportion of materials for cement mortar angle fillets shall be of PVC proprietary make wherever so specified.

#### **2. WORKMANSHIP:**

Materials for screed shall be mixed on the Work site in a batch mixer of approved size and design producing a uniform distribution of materials with mass of uniform colour and consistency.

The concrete deck to receive screed shall be well brushed to remove laitance. Before laying screeds, the surface of the concrete shall be made free from surface dust and damped with clean water. The Contractor shall not proceed with laying screed or angle fillets until the Engineer has approved the existing concrete deck surface.

The Contractor shall lay screeds to the specified thickness and/or falls as shown in the drawings and in alternate bays not exceeding 10 m<sup>2</sup>. The slope of screed shall be 1 in 100 unless otherwise stated. Stop-ends shall be vertical and positioned to coincide with construction joints in the concrete deck. Screed and angle fillets shall not pass over roof expansion joints in the concrete deck. All screeded surfaces shall be finished to a true and even surface, over whole areas to within plus or minus 3mm, when tested with a 3000mm long straight edge. The rate of departure shall not be greater than 1.5mm for each 500mm in distance from any point of contract along the straight edge.

Expansion joints shall comprise impregnated fiber joint filler board to the specified width or as shown in the drawing. The sealant shall be as specified in the drawing and Section 02.05 Concrete Works.

Screed and angle fillets shall be finished smooth and even with a wood float finish. Where specified, a steel trowel shall be applied lightly to present an even dense surface without laitance occurring. The entire surface shall be protected from premature drying and rapid temperature change by covering with sand or hessian or polythene sheeting, and kept continuously damp for a minimum period of 4 days. Care shall be taken to ensure that the sheeting is securely fixed during this period to prevent wind blowing under the covering.

### 03. WATER PROOFING

#### 1.GENERAL:

Unless otherwise specified water proofing is to be provided in toilets, kitchen, pantry, planter boxes, lift pits, basement, pile caps and any other area subjected to wet conditions.

The water proofing system and associated works shall be carried out by a Specialist Agency approved by the Engineer, strictly in accordance with the manufacturer's printed instructions. Prior to commencement of works, the Contractor shall submit all relevant technical data and method statement to Engineer for approval. The Contractor shall submit at least 3 specialist Agencies name with their credentials for approval and the Engineer may approve one or more agencies.

#### 2.MATERIALS AND METHOD

##### Bitumen Roofing Felt

The water proof roofing felt shall be preformed, self adhesive and of tropical grade. The number of layers shall be as specified in the drawing. It shall comply with the following requirements.

Thickness	:	4mm
Tensile Strength (ASTM D 828)		
Longitudinal, N/5cm	:	23KN/m
Transverse, N/5cm	:	15.8 KN/m
Tear resistance (ASTM D 1004)	:	270N/mm.
Reinforcement	:	200 gm/m <sup>2</sup> non woven polyester

Water Absorption : Less than 0.12% by weight

### **Water Proofing Additives**

The waterproofing additives to Concrete and mortar for plastering shall be of approved make and incorporated in the mix at the rate of 4.55 liters per 50 kg of cement or as per manufacturer's instructions.

### **C. Cementitious Water proofing Membrane**

Cementitious water proofing membrane shall be of approved make and laid strictly in accordance with the manufacturers instructions. Application shall be in two coats at 2kg/m<sup>2</sup> or as specified by the manufacturer. This shall generally be used in the floors of toilets, planter boxes, under ground tanks, trenches, machinery foundations etc. The water proof membrane shall be carried up to adjoining vertical surfaces to a height of not less than 300mm or as shown on drawings, and turned into sealing chases all in accordance with the manufacturer's instructions.

### **D. Treatment on PCC leveling course**

Treatment on the top surface of PCC leveling course and cured well before placing and tying of reinforcement for base slab shall be done as given below::

- i. After the PCC is cured fully, the surface shall be cleaned well as specified in section 01 above and approval of Engineer is to be taken before starting the work.
- ii. Apply 12mm thick plaster with cement sand mortar (1:3) admixed with approved water proofing compound at the rate specified by the manufacturer shall be laid on top of the PCC surface as per specifications and instructions of the manufacturer. The plaster shall be finished smooth with a steel trowel and cured for 1 day.
- iii. After curing the plaster surface for at least 3 days it shall then be coated with two (2) coats of acrylic polymer modified cement based flexible water proofing slurry of approved make as per manufacturer instructions. The coating shall be cured with water for 1 day.
- iv. The surface shall then be covered with another 25mm thick plaster with cement sand mortar (1: 3) admixed with approved water proofing compound at the rate specified by the manufacturer as per specifications and instructions of the manufacturer. The plaster shall be finished smooth with a steel trowel and cured for 3 days.

Base slab concrete as per drawing and specifications shall be laid over this treated surface.

## **17 E. Treatment to sidewalls from exterior surface**

RCC retaining walls and other underground structures like sump, lift pit, trenches etc. shall be treated as given below:

- 1) After concrete is cured as per the standard practice, chemical injection treatment in the form of pressure grouting shall be done as detailed below:
  - i. 18mm dia. Holes shall be drilled on exterior surface of wall to required depth using pneumatic hammer drill in grid pattern at a spacing not exceeding 1 m interval center to center. Particular care should be taken to drill holes and fix nozzles along the construction joint line wherever it occurs and on other vulnerable areas.
    - ii. The depth of nozzles shall be adequate to push the grout at all depth. GI nozzles shall be fixed in the holes drilled using quick setting additive of approved make.
    - iii Cement Slurry mixed with non shrink polymer grouting compound as per manufacturer's recommendation shall be injected through the prefixed nozzles under pressure using grout pump to fill all possible pores and gaps left within the concrete mass. When the flow of the grout stops the grout mains shall be disconnected.
  - iv The GI nozzles shall be sealed off with approved rapid setting mortar and the grout holes are finished after cutting the projecting nozzles.
- 2) After Chemical Injection treatment is over the surface of wall shall be cleaned and prepared for applying Cementitious water proofing membrane as specified in Section 01 above. The prepared surface shall be coated with two component acrylic polymer modified cement based flexible water proofing slurry of approved make to a thickness of 2mm as per manufacturer instructions and shall be cured with water for 1 day.
- 3) On top of the coating concrete block masonry of 100mm thick or cuddapah stone slab or 12mm thick plaster mixed with water proofing compound shall be provided as a protection to the water proofing membrane. The type of protective coat shall be as given in the drawing or as directed by the Engineer.

## **F. Treatment to base slab etc.**

The base RCC slab shall be treated with pressure grouting as specified under e) above. Similar treatment shall be given to lift pit slab, cover slab, trenches, piles and pile caps as specified in the drawing.

## **18 G. Treatment to Water Tanks**

Apply directly to prepared and pre-wetted concrete floor, walls and underside of slab if specified with two coats of approved Cementitious water proofing system at specified rate by manufacturer. A protective coat of cement and sand plaster 1:3 admixed with water



proofing compound at the rate as specified by the manufacturer after the water proofing has completely set and cured.

#### H. Waterproofing Membrane For Roof

The waterproofing membrane shall be LLOYD's ISOTHANE.EMA or approved equivalent products and it consists of the following:

- 1. Base Screeding shall be of PCC 1:1.5:3 concrete with 12mm down graded aggregates and thickness as specified in the drawing or as per manufacturer's instruction. Water Proofing Additive to Screeding shall be added, mixed and laid as per manufacturer's instruction.**
2. Prepare the substrate as previously described. Primer the surface with Isothane special primer or approved equivalent at 6-10 m<sup>2</sup> per litre or as per manufacturer's recommendations. Apply one coat of ISOTHANE.EMA of 0.5mm thick waterproofing membrane or approved equivalent. The first coat shall be touch dry in 12-48 hrs and second coat of ISOTHANE.EMA of 0.5mm thick or approved equivalent shall be applied within 24 hrs of this stage or as per manufacturer's recommendations.
- 3 Lay 25mm thick cement screed (1 :3) with waterproofing compound as protective layer immediately after the installed membrane has passed the water test.
- 4 Over the protective screeding layer cast-in-situ cement concrete (1:2:4) panels of 900 X 900 x 50 thick with 12mm down graded aggregates shall be cast with "V" shaped groove at the top and the grooves filled up with bitumen sealing compound.

#### **I Crystalline method**

This will be as per manufacturers printed manual.

### **04 WORKMANSHIP**

#### **1 SURFACE PREPARATION**

The concrete surface to be waterproofed should be even and smooth with any "high spots" knocked back and local depression and sudden changes filled with epoxy mortar or similar high strength mortar to present a true surface on which the waterproofing membrane is to be bonded. All sharp projections and arises caused by form work etc.. should be "scrabbled back" to give rounded corners.

Surface of concrete to be dry and brushed free of any loose stones, dirt, etc., before brush applying a single coat of approved Primer, which should be touch dry prior to the application of waterproofing membrane. Primer must not be poured onto the surface and care must be taken to avoid "ponding" in depressions. All internal angles shall be formed with fillets of profile as specified.

## **2. APPLICATION**

The laying of waterproofing membrane should commence from the lowest point to ensure weather overlaps. The membrane when meeting against the parapet or the upturn, shall turn up for at least 300mm high from finished level and with top edge tucked in groove formed on wall or upturn and filled with an approved mastic

Using the lath provided, the protective paper shall be peeled back and the adhesive surface of the waterproofing membrane unrolled on the prepared concrete surface. The material should be brushed onto the surface to ensure that air is excluded from under the membrane. All joints should be overlapped a minimum of 150mm and the laps shall be rolled with a heavy rubber tyred wheel or similar to provide continuous adhesion and thus ensure water-tightness of the system.

All inside and outside angles should be initially provided with an additional 300mm wide strip centered along the axis of the corner, prior to applying waterproofing membrane.

At expansion/movement joints, the joint cover shall be provided as shown in the drawings and as per approved manufacturer's recommendation.

## **3 INTERNAL AND EXTRNAL CORNERS**

External corners where possible should be trowelled to provide a 15mm X 15mm minimum splay. Waterproofing membrane must not be stretched through corners, but carefully dressed and eased around the angle. Both internal and external corners to have "cut cloaked" detail with gussets as shown on the detailed drawings. In the absence of specific details in the drawings approved, standard manufacturers' details shall be followed.

## **4 UPSTANDS**

Where the water proofing membrane is to be terminated at an upstand, a chase should be provided of dimensions 20mmx20mm. The waterproofing membrane should be dressed into the chase and securely fixed with a tanalised timber in between and pointed immediately with approved Mastic. If exposed to the weather, the waterproofing membrane should be protected with approved solar reflective flashing strip or with a metal counter-flashing strip.

## **5 DRAINAGE AND PIPES**

Details of the termination of the membrane at drainage gulleys, gargoyles, upstands and expansion joints shall be carried out strictly in accordance with the details shown on the working drawings. In the absence of specific details in the drawings, the work shall be carried out as per approved, standard manufacturers' details.

At all gargoyle openings, stainless steel welded mesh (Square pattern) made of 3 mm wire shall be provided. The mesh shall overlap with the gargoyle edges by 100 mm on each

direction and shall be held in place by insulation/pea gravel. The cut edges of the mesh shall be trimmed back to cross wires so as to avoid sharp protruding wires.

## **6 PERIMETER**

The perimeter of waterproofing membrane placed in any given day's operation shall have free edges sealed by rolling down tightly to prevent entry of moisture.

The perimeter of waterproofing membrane is to be left with an extended edge for later continuity and the free edge is to be adequately protected while exposed. The free edge of waterproofing membrane should be carefully cleaned before further laying is commenced.

## **7 PROTOTYPE MOCK UP**

The Contractor shall carry out a sample area of roofing, (minimum area 10 sq.m.) including jointing between sheets, perimeter upstands and flashings, and work to the gargoyles, sleeves, expansion joints etc. together with samples of internal and external angles

## **8 INSPECTION**

Immediately prior to covering the membrane careful inspection shall be made for accidental damage, and any damaged areas shall be cleaned and patched with the same waterproofing membrane.

## **9 PRECAUTIONS**

The following procedure should be carefully noted:-

The area of waterproofing membrane laid in a working day should not exceed that which can be protected in the same working period.

No storage of materials or trafficking by other trades shall take place on areas waterproofed until subsequent protective materials have been laid.

## **10 SOLAR REFLECTING STRIP FOR UPSTANDS**

The siliconised released paper shall be removed and the shield applied-self-adhesive face towards the structure and applied transversely in a similar manner as waterproofing membrane with 150 mm edge overlaps, which shall be well rolled to ensure full watertight continuity.

On the vertical face of parapets and upstands the Solar-shield shall be overlapped 150mm or as necessary, and turned into 20 x 20 mm chase and pointed with Mastic.

Aluminum flashings and sheeting wherever indicated for use in the roofing shall conform to BS 1470 and shall be 0.9mm thick, unless otherwise specified. The flashing shall be custom made to the profiles indicated in the drawings. In the absence of specific details, approved, standard profiles shall be used.

## **11 WATER TESTING**

Before insulation is laid, the gargoyles shall be closed and the membrane flooded to a minimum of 100mm depth so that the entire roof area is immersed. The water will be maintained for this depth for minimum 3 days. If no dampness appears on the soffit of the slab the test shall be deemed to have been passed after the inspection of the Engineer. The Contractor shall carrying out this test twice, once after the Water Proofing membrane is laid and the other after the finishing work is completed, if directed by the Engineer. If there are dampness on the soffit of the slab, suitable rectification work as suggested by the Contractor and approved by the Engineer shall be carried out and water testing is to be repeated after the rectification work.

## **12 OTHER TESTS**

The ENGINEER reserves the right to order for taking samples of waterproofing materials or accessories delivered or used at the work and subjects them to chemical or physical tests to determine if they comply with specifications. If they do not comply then materials shall be rejected and any materials that have been built in shall be rejected and shall be taken out and removed from the site and replaced with proper materials that are in accordance with the specification.

## **13 GUARANTEE FOR 10 YEARS**

The Contractor and the Specialist Agency shall jointly provide a 10 year warranty for the completed Water Proofing work on its performance against any defects and failure as water proofing system in particular to its prevention of water penetration. If different agencies are deployed for roof, toilet, basement etc., the warrantee shall be provided for each separately. During the said period, if any leakage or dampness is noticed, the same shall be rectified by the Contractor and the cost involved in the above rectification or redoing including the connected insulation and tiling work etc. shall be borne entirely by the Contractor.

## **05. UNDER DECK INSULATION**

Insulation panel shall be 50 mm thick {2 x 25 mm or 1 x 50 mm) under deck insulation material conforming to IS 8183 (Such as ROCK LLYOD/LAPROCK/SPINTEX SLABS OR EQUIVALENT) having a minimum density of 32 kg/cum. Thermal conductivity of 0.0372 W/m<sup>2</sup>K @ 10°C or lower, with exposed face covered with 1mm (minimum) thick aluminium foil (Facing done either at factory or at site) installed under concrete roof including all connected works such as but not limited to wood pegs, slotted angle pieces with rawl plugs and coach screws for fixing the insulation to roof.

The insulation shall be supported by 24 SWG x 25 mm square wire mesh net which is tightly held to ensure intimate contact with the under side of the roof and held in position by 14 G GI tie wires in criss cross arrangement, tied around the angle cleat pegged to roof slab through rawl plugs screwed on to wooden pegs left in slab while casting

The Contractor shall protect the insulation from wind uplift and ultra violet degradation prior to laying of subsequent finishes and shall protect the insulation from damage and

replace any such damaged sheets as directed. Also this work is to be coordinated with the other works at ceiling like AC ducting, false ceiling, Electrical, fire protection etc.

## **18.0 INTERIOR PARTITION WALLS**

### **18.01 Gypsum partition walls**

Providing and fixing 75mm thick partition made with 2" X 2" SAL WOOD framework. The aluminium sections shall be placed at 2' 0" c/c both ways and rigidly connected together as per the detail drawings. Aluminium framework shall then be cladded with 2 x 12.5 mm thick Gypsum boards with GI edge binder, corner guards of IGL make and executed as per the the IGL's manufacturers recommended specifications.

It should be ensured that all the gypsum board joints of the first layers also to be neatly finished with jointing compound and fibre tape to achieve better acoustic properties as per Architects recommendations. The partition to have 48 kg/ m<sup>3</sup> density (600 GSM), 50mm thick Aunotone make Sound synth infill to required sizes as approved by the Architects. Care to be taken that the Gypsum boards and SALWOOD frames are raised 3mm from the floor and stop 3mm short of true ceiling to create a the gap for full length of partition. The gap shall be injected with acoustic rated caulking compound sealant of approved make for successive layers and bottom and top of the SALWOOD members as per the detail drawings for full length of partition.

All the gypsum surfaces shall then be finished in fibre tape, two coats of under coats as per the IGL's manufacturer's specifications. All the gypsum surfaces below the false ceiling from both surface shall be finished with washable plastic emulsion paint of approved shade and make over the coat of primer. ( For painting specification refer to painting clause ). Proper punning to be done with Plaster Of paris prior to the application of painting with enamel.

The partition shall also have 100mm high 19mm thick post formed MDF skirting finished with Autocoat paint finish on both sides with 12mm thick ply backing as per the detail drawings. The grooves shall be properly made in straight lines with edges neatly finished with India Gypsum make veneer gypplaster as per the manufacturers specifications.

The work also to include final finishing of the partition walls after service works and handing over the same complete in all aspects.

### **18.02 Partition with Aerocon Panels or Equivalent**

Aerocon panel is an interlocking sandwich panel with tongue and groove jointing system, made up of two fibre reinforced cement sheetson either side of light weight concrete core composed of

Portland cement, binders, fibres, fly ash and light weight mineral aggregate. The tongue and groove system ensures easy and quick installation at site

18.02.01

### Physical Dimensions

Thickness ( mm)	Weight Kg /sqm	Width ( mm)	Length ( mm)	Tolerance ( mm) ( T,W & L )
50	39	600	2400,2700,3000	+/-1
75	54	600	2400,2700,3000	+/-1

18.02.02

### Characteristics

Properties	Units	50mm thk	75mm thk	Remarks
Axial load	KN/M	53	83	Factor of Safety – 2.5
Bending Strength 2.9 M span ( Safe design load 1.5 M span )	Kg / m	81 220	109 295	Factor of Safety – 2.5
Flexural Strength	Kg/sqcm	67	58	Typical test results
Compressive strength	Kg/sqcm	50	70	Typical test results
Thermal Conductivity	W/m deg K	0.22	0.21	As per BS4370 – part 2
Sound transmission coefficient	db	33	36	IS:9901(Part III)-1981 IS:11050(Part I)-1981
Fire rating	Minutes	120	120	BS 476 part 20 – 22
Surface spread of flame	Class	I	I	BS 476 Part7 – 1971
Fire propagation index	Class	I	I	BS 476 Part6 – 1981
Ignitability	Class	P	P	BS 476 Part5 – 1968

### 18.03 Partition with Aerocon Blocks or Equivalent

Aerocon blocks are light weight blocks of 600x200mm size with 100,150 and 200mm thickness.

With corresponding dry weights of 7, 10.5 and 14 Kgs with minimum compressive strength of 3 N/sqmm, normal dry density 551-600 Kg per Cum as per IS 2185 part 3, 1985 grade 2, with sound reduction of 37- 45 db.

The edges of the blocks are such that they allow easy workability and accurate dimensioning. Aerocon blocks are easier to install as opposed to the installation and usage of conventional building materials where construction deadline is short and labour scarcity is acute and mortars are to be used.

The time required for the installation of Aerocon Blocks is about 1/3rd as compared to the time required for the installation of conventional Building materials. Aerocon blocks are available in various sizes and shapes. They are included into the category of Green Building materials because they don't emit VOC (Volatile Organic Compounds) which cause environmental pollution.

#### **APPROVED MAKE/ BRAND OF MATERIALS**

##### **ITEMS APPROVED BRANDS**

Cement:	Ultratech / Birla group /HOLCIM group As approved by the Employer
Structural Steel	: SAIL / TISCO / JINDAL / As approved by the Employer
Reinforcement	: SAIL / TISCO / JINDAL / As approved by the Employer
Waterproofing compound	: SIKA/ Accoproof/ CICO No.1/ Impermo / Fosroc / As Approved by the Employer
Ceramic /Vitrified Tiles	: Kajaria /Nitco/Johnson or equivalent make

Glazed Ceramic tiles for dado	:	Kajaria /Nitco/Johnson or equivalent make
Tile Adhseive	:	Ms. BAL /Laticrete
White Wall Putty	:	Birla or equivalent.
Floor Springs	:	Everite or equivalent
GI Mesh/ Mosquito shutter	:	Netlon(Diamond)/Arpitha or equivalent
Door Hardwares	:	Dorset/Godrej /magnum
35mm Flush shutter	:	Archidply/Greenlam/Greenply
Glass	:	SaintGobain
2Hr fire rated door	:	Firepro or equivalent
2 Hr fire rated Door	:	Shakti met or equivalent
Sealants	:	Dow Cowing
Aluminium Extrusions	:	Zindal/Hindalco or equivalent
Paint	:	Asian/Berger /Jotun/Duracem/Snowcem
Silicone Gaskets	:	EPDM or equivalent
MS Tubular or Square section	:	TATA or equivalent

**Note:**

1. All materials supplied to have I.S.I. approval/ marking.





2. The choice of approval for alternate makes shall lie with the Employer and contractor to obtain written approval before procuring and quoted rates are deemed to be included for any make.
3. Contractor shall submit MTC for all materials procured by their vender.

**Annexure-D**

**TECHNICAL SPECIFICATION**  
**FOR**  
**PLUMBING AND SANITARY INSTALLATION WORKS**

**PLUMBING & SANITARY INSTALLATION - INDEX**

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## **1.0 GENERAL PROVISIONS FOR PLUMBING INSTALLATION**

(To be read in conjunction with the Tender Conditions and General Conditions of Contract)

### **1.1 SCOPE OF WORK**

The contractor shall carry out and complete the said work under this contract in every respect in conformity with the rules and regulations of the local authority. The contractor shall furnish all labour, supply and installation of all materials, appliances, tools and equipment necessary for the entire work and testing all the plumbing services installation as specified herein, as per the relevant Bureau of Indian Standards (BIS), British Standards codes. This also includes any material, appliances and equipment not specifically mentioned herein or noted on the specifications as being furnished or installed which are necessary and customary to make a complete installation properly connected and in working order.

In general the work to be performed under this contract shall comprise of the following:

- 1.1.1** All incidental works connected with plumbing services installation such as excavation of trenches and back filling, cutting & chasing in concrete and brick and making good, cutting/drilling holes through walls, floors, and grouting for fixing of fixtures/equipment, etc.
- 1.1.2** Furnish and install a complete workable plumbing services installation as described in this specification and as per the latest Bureau of Indian Standards (BIS), British Standards (BS) specifications including all that which is reasonably inferred.
- 1.1.3** Complete installation of internal and external water supply system.
- 1.1.4** Complete installation of the sewerage and sewerage appurtenances internally as well as around the building.
- 1.1.5** Complete installation of all sanitary and plumbing fixtures.
- 1.1.6** Co-operation with other crafts in putting the installation in place. Any work done without regard or consultation with other trades, shall be removed by the contractor without additional cost to the Client, to permit proper installation of all other work, as desired by the Architect /Client.
- 1.1.7** Repair all damage done to the premises as a result of this installation and remove all debris left by those engaged for this installation to the satisfaction of Client.
- 1.1.8** Cleaning of all plumbing and sanitary fixtures, testing and proving the satisfactory performance of all fixtures at the time the building is handed over to the Client.
- 1.1.9** It is the responsibility of the contractor to take care of all the fixtures fitted until the time of handing over to the Client.
- 1.1.10** Painting of all concealed and exposed pipes as specified.

**1.1.11** Assume full responsibility of all required applications and costs to connect to Corporation water mains, sewers and storm water drains, to the extent applicable to this installation.

## **1.2 CONTRACTOR**

The contractor shall be licensed plumbing contractor possessing a valid plumbing contractors license employing Engineers, Technicians, Foremen, Plumbers, Masons, Helpers, etc., as required.

## **1.3 REGULATIONS AND STANDARDS**

The installation shall conform in all respects to the following standards in general:

IS 651 – 1992	: Specification for Salt Glazed stoneware pipes and fittings (fifth revision).
IS 7558 – 1974	: Code of practice for domestic hot water installation
IS 5329 – 1983	: Code of practice for sanitary pipe work above ground for buildings.
IS 12251 – 1987	: Code of practice for drainage of building basements
Is 2064 – 1973	: Code of practice for selection, installation and maintenance of sanitary appliances
IS 6924 – 1973	: Code of practice for construction of refuse chutes in multistoreyed buildings
IS 1200 ( Part 1)	: Method of measurement of building earthwork
IS 1200 ( Part 16)	: Method of measurement of laying of water and sewer lines including appurtenant
IS 1200 ( Part 19)	: Method of measurement of Water supply, plumbing and drains.
IS 783 – 1959	: Code of practice for laying of concrete pipes
IS 13592 – 1992	: Specification for unplasticized PVC pipes for soil and waste discharge system inside building including ventilation and rainwater.
IS 2527 – 1984	: Code of practice for fixing rainwater gutters and down pipes for roof drainage.
IS 2685 – 1971	: Code of practice for selection, installation and maintenance of sluice valves.
IS 6784 – 1984	: Method of performance testing of water meters (Domestic type).
IS 12235 ( Parts 1 to 11)	: Methods of test for unplasticized PVC pipes for portable water

supplies.

IS 458 – 1988	: Specification for precast concrete pipes (with or without reinforcement)
IS 2692 – 1989	: Specification of ferrules for water services
IS 12701 – 1989	: Specification for rotational moulded polyethylene water storage tanks.
IS 771 – ( Part 3to 6)	: Specific requirements for urinals
IS 2548 ( Part 1&2 )	: Specification for plastic seats and covers for water closets.
IS 3004 – 1979	: Specification for plug cocks for water supply purposes.
IS 1711 – 1984	: Specification for self closing taps for water supply
IS 1703 – 1977	: Specification for ball valves (Horizontal plunger type) including floats for water supply purposes.
IS 4038 – 1979	: Specification for foot valves for water works purposes.
IS 782 – 1978	: Specification for Caulking Lead.( Third revision)
IS 1172 – 1983	: Code of basic requirements for water supply, drainage & sanitation (revised).
IS 1239 – 1990 (Part I)	: Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1239 – 1992 (Part II)	: Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1726 – 1991	: Code for cast iron manhole frame and cover (third revision).
IS 1742 – 1983	: Code of practice for building drainage.( Second revision)
IS 2064 – 1973	: Code of practice for selection, installation and maintenance of sanitary appliances.
IS 2065 – 1983	: Code of practice for water supply to buildings.
IS 3114 – 1985	: Code of practice for Laying of CI pipes
IS 4111 – 1986	: Code of practice for Ancillary structures in sewerage system
IS 4127 – 1983	: Code of Practice for laying glazed stone ware pipe.
BS 4515	: Specification for unplasticized PVC pipe fittings.

- IS 4985 – 1988 : Specification for unplasticized PVC pipes for portable water supplies ( second revision)
- IS 732 & IS 2274 – 1963 : Indian Standard code of practice for electrical wiring & installation.
- IS 1536 – 1976 : Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
- IS 1537 – 1976 : Specification for vertically cast iron pressure pipes for water, gas and sewage.
- IS 1538(part 1to23) – 1976 : Specification for cast iron fittings for pressure pipes for water, gas and sewage.
- IS 1729 – 1979 : Specification for sand cast iron socket and spigot soil, waste and ventilating pipes, fittings and accessories.
- IS 780 – 1984 : Specification for sluice valves for water works purposes.

National building Code for Water Supply, drainage and Sanitation. Part IX Plumbing services section 1 & 2.

The installation shall also be in conformity with the bylaws and requirements of the local authority in so far as these become applicable to the installation. Wherever this specification calls for, a higher standard of materials and /or workmanship than those required by any of the above regulations and standards, then this specification shall take precedence over the said regulations & standards. Wherever drawings and specifications require something that may violate the regulations, the regulations shall govern.

#### **1.4 FEES, PERMITS AND NOTICES**

Contractor shall comply with all bye-laws and regulations of local and other statutory authorities having jurisdiction over the works and shall be responsible for the payment of all fees and other charges and giving and receiving of all necessary notices. Contractor shall keep the Employer timely informed about regulations and requirements of statutory authorities and shall obtain the final certificates of inspection and approval from the authorities.

#### **1.5 DRAWINGS AND SPECIFICATIONS**

contractor shall submit the detailed drawings as per specifications to complete the building in all respects within 30 days of award of order as part of scope of this contract .Approval of the Owner /Client shall be obtained before commencement of work.

#### **1.6 SHOP DRAWINGS**

The contractors shall submit to the employer four copies of the shop drawings.

**1.6.1** Show drawings shall be submitted under the following conditions

**1.6.2** Showing any changes in layout in the contract drawings.

- 1.6.3** Floor plans, Enlarged toilet details, schematic showing water supply and sanitary installation works
- 1.6.4** Pumps/Equipment layout, control panel, wiring and piping diagram.
- 1.6.5** Manufacturer's or Contractor's fabrication drawings for any materials or equipment.
- 1.6.6** The contractor shall submit four copies of catalogues, manufacturer's drawings, equipment characteristic data or performance charts as required by the client.
- 1.7 AS BUILT DRAWINGS**
- 1.7.1** On completion of works, contractor shall submit one complete set of original tracings and two prints of "As built" drawings to the client. Also contractor to furnish soft copy of "As built " drawings. These drawings shall have the following information.
- 1.7.2** Exact run and sizes of all piping on all floors and vertical stacks.
- 1.7.3** Ground and invert levels of all drainage pipes together with location of all manholes and connections upto outfall.
- 1.7.4** Run of all water supply lines with diameters, location of control valves, access panels.
- 1.7.5** Location of all mechanical equipment with layout and piping connections.
- 1.7.6** Contractor shall provide four sets of catalogues, performance data and list of spare parts together with the name and address of the manufacturer for all plumbing and mechanical equipment provided by him.
- 1.7.7** All "Warranty Cards" given by the manufacturer's shall be handed over to the Client.
- 1.8 MANUFACTURER'S INSTRUCTIONS**  
Where manufacturers have furnished specific instructions relating to the materials used in this job and methods of construction that are not specifically mentioned in these documents, such instructions shall be followed in all cases.
- 1.9 MATERIALS**  
Materials shall be of approved make and quality specified. They shall conform to the respective Bureau of Indian Standard Specifications and supported by Manufacturing Certificate.
- 1.10** Samples of all materials shall be as per the list of approved brand manufacture, which shall be got approved before placing order and the approved samples shall be deposited with the Employer.
- 1.11** In any case of non-availability of materials in metric sizes, the nearest size of FPS units shall be provided with prior approval of the Architect/Engineer, for which no extra cost will be paid.



## **2.0 UNDERGROUND TRENCHES**

### **2.1 ALIGNMENT AND GRADE**

Drains are to be laid to correct alignment & grade & to meet the requirements of the works. No deviations from the lines, depths of cutting or gradients of sewers shown in the plans and sections shall be permitted except by the express direction in writing of the Architect/Engineer. The pipe shall be laid to slope with the socket and spigot ends on higher and lower side respectively.

### **2.2 OPENING OUT TRENCHES**

In excavating the trenches, the road metalling, pavement kerbing, etc., are to be placed on one side and preserved for reinstatement and the trench or other excavation shall be filled up and laid back to original condition at no extra cost. Before any road metal is replaced, it shall be carefully shifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Employer. The contractor shall not cut or break down any live fence or trees in the line of the proposed works but shall tunnel under them unless the Employer orders the contrary. The contractor shall scrub and clear the surface over the trenches and other excavations of all stumps, roots and other encumbrances affecting execution of work and shall remove the same from the site as per the directions of the Architect/Engineer.

### **2.3 EXCAVATION TO BE TAKEN TO PROPER DEPTH**

Trenches shall be excavated in all conditions of soil and to such a depth that the sewers shall rest as described in the several clauses relating thereto and so that the inverts may be at the levels given on the section. In bad ground, the Engineer may order the contractor to excavate the trench to a greater depth than envisaged during engineering and to fill up the excavation to the level of the sewer with concrete, sand, gravel, or other materials. For such works the contractor shall be paid extra at the rates laid down for such works in the schedule, if the extra work was ordered by the Employer/Engineer in writing. But if the contractor should excavate the trench to a greater depth than is required without a specific order to that effect in writing of the Employer/Engineer, the extra depth shall have to be filled up with concrete at the contractors own cost to the requirements and satisfaction of the Engineer.

### **2.4 REFILLING**

After the sewer or other work has been laid and proved to be water-tight, the trench or other excavation shall be refilled. Utmost care shall be taken in doing this so that no damage is caused to the sewer and other permanent works. Filling in the trenches upto 50 cms. above the crown of the sewer shall consist of the finest selected materials placed

carefully and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 15 cms. layers with material taken from the excavation, each layer being watered and consolidated.

## 2.5 BACK FILLING OF TRENCH – I S 12288-1987

For the purpose of back filling, the depth of the trench shall be considered as divided into the following three zones from the bottom of the trench of its top, for the purpose of refill materials to be used.

- ZONE A : - From the purpose of back filling, the depth of the level of the centre line of the pipe.
- ZONE B : - From the level of the centre line of the pipe to a level 30 cm above the top of the pipe, and
- ZONE C : - From a level 30 cm above the top of the pipe of the top of the trench.

## 2.6 BACKFILL MATERIALS

All backfill materials shall be free from cinders, ashes, slag, refuse, rubbish, vegetable or organic materials, lumpy or frozen materials boulder, rocks or stone or other materials which in the opinion of the Engineer-in-Charge, is unsuitable for deleterious. Fire excavated earth which shall pass through a sieve of aperture size 20mm can be used for filling in zones A & B. However, material containing stones upto 20mm as their greatest dimension may be used in zone C only unless otherwise specified by the Engineer-in-Charge. Where excavated material is considered by the Engineer-in-Charge not suitable for back filling, clean river sand shall be used for the same.

## 2.7 BACK FILL SAND

River sand used for back fill shall be a natural sand complying with para 2.5 graded from fine to coarse. The total weight of and clay in it shall not exceed 10 percent. All material shall pass through a sieve of aperture size 20mm (IS-2405-1980) and not more than 5 percent shall remain on IS sieve of aperture size 6.30mm.

## 2.8 BACK-FILL GRAVEL

Gravel used for back fill shall be natural gravel and having durable particles graded from fine to coarse in a reasonably uniform combination with no boulders or stone larger than 50mm in size. It shall not contain excessive amount of loam and clay and not more than 15 percent shall remain on a sieve of aperture size 75 micron.

2.9 Back filling in zone A shall be done by hand with fine excavated material or river sand, find gravel or other approved materials placed in layers of 8cm and compacted by tamping. The back filling material shall be deposited in the trench for its full width of each side of the pipe, fittings and appurtenances simultaneously.

2.10 Back-filling in zone B using fine excavated material shall be done by hand or approved mechanical methods using the fine excavated material special care being taken to tamping and to avoid injuring or moving the pipe. If excavated material is not suitable

the type of back-fill material to be prescribed by the Engineer-in-Charge to suite individual locations.

**2.11** Back filling in zone C shall be done by hand or approved mechanical methods and well compacted. Excavated earth having stones of size not exceeding 20mm can be used for zone C. If the excavated earth unsuitable for back fill the filling material shall be specified by Engineer-in-Charge.

**2.12 BACKFILL WITH EXCAVATED MATERIALS**

Where the excavation is made through permanent pavements, curbs, paved foot paths, or where such structures are undercut by the excavation, the entire back fill to the sub-grade of the structures shall be made with sand or cement concrete in accordance with para 2.5. The method of place and consolidating the back fill material shall be prescribed by the Engineer-in-Charge.

**2.13 PLAIN CEMENT CONCRETE OVER PIPES**

When pipes are laid under roads and pavements subjected to heavy traffic loads the trenches may be covered with plain cement concrete of suitable dimension, supported on edges to relieve the load on pipes to the adjoining earth.

**2.14 SITE CLEANING ON COMPLETION OF WORK**

All surplus pipes and fittings, valves, etc., and all tools and temporary structures shall be removed from the site as directed by the Engineer-in-charge. All dirt, rubbish and excess earth from the excavation shall be removed and transported and disposed at a suitable place as directed by Engineer-in-Charge and the construction site left clean to the satisfaction of the Engineer-in-Charge.

**2.15 CONTRACTOR SHALL RESTORE SETTLEMENT AND DAMAGES**

The Contractor shall at his own cost make good promptly, during the whole period that the works are in hand, any settlement that may occur on the surfaces of roads, beams, footpaths, gardens, open spaces, etc. whether public or private caused by his trenches or his other excavations and he shall be liable for any accidents caused thereby. He also shall, at his own expense and charge, repair and make good any damage done to the buildings and other properties.

**2.16 DISPOSAL OF SURPLUS**

The Contractor shall at his own cost dispose within the site or as directed all surplus excavated materials not required to be used in the work.

**2.17 TIMBERING**

The Contractor shall at all times support efficiently and effectively the sides of trenches and other excavations by finest selected timbering, piling, sheeting material, etc. The trenches shall be close timbered in loose or sandy strata and below the surface of the sub-soil table. All timbering, sheeting and piling with their walls and supports shall be of adequate dimensions and strength and fully braced and strutted so that there is no risk of collapse or subsidence of the walls of the trench. The Contractor shall be held accountable and responsible for the adequacy of all timbering, bracing, sheeting and piling used and for all damages to persons and property resulting from the improper quality, strength, placing, maintenance, or removing of the same.

**2.18 REMOVAL OF WATER**

The Contractor shall at all times during the progress of work keep the trenches and excavations free from water which shall be disposed off by him in a manner as will neither cause injury to public health nor to public or private property, to the work completed or in progress, to the surface of any roads or streets and cause any interference with the use of the same.

**2.19 TRENCH WIDTH**

The width of excavated trenches shall be as per the table given below:

Width at bottom

	Upto 100 mm dia pipe	Upto 150 mm dia pipe	Upto 300 mm dia pipe
Excavation upto:			
900 mm depth	330 mm	330 mm	600 mm
900 to 1500 mm depth	600 mm	600 mm	900 mm
1500 to 3000 mm depth	750 mm	750 mm	1100 mm
3000 to 5000 mm depth	900 mm	1000 mm	1300 mm

**2.20 PROTECTION OF EXISTING SERVICES**

All pipes, water mains, cables, etc. met with during the course of excavation shall be carefully protected and supported.

**2.21 ROAD CROSSINGS**

All pipelines laid below roads shall be taken through suitable underground trenches.

**2.22 CONSTRUCTION ACROSS ROADS**

All works across roads shall be carried out as per the directions of the Architect/Client.

**2.23 MODE OF MEASUREMENT**

Measurement for excavation of pipes trenches shall be made per linear meter under the respective category of soil classification encountered at site.

- Ordinary soil
- Hard soil (Hard murrum / soft rock)
- Hard rock requiring chiseling
- Hard rock requiring blasting

### **3.0 SOIL, WASTE, VENT AND RAIN WATER PIPES**

#### **3.1 SCOPE OF WORK**

Work under this section consists of furnishing all labor, materials, equipment and appliances necessary and required to completely install soil, waste, vent pipes and rain water as required, specified herein after and given in the bill of quantities.

Without restricting to the generality of the foregoing, the soil waste and vent piping system shall include the following: -

- a) Vertical and Horizontal Soil & Waste centrifugal CI pipes and fittings, joints, clamps and connections to fixtures.
- b) Connection of all pipes to sewer lines.
- c) Floor and urinal traps cleanout plugs and inlet fittings.
- d) Testing of all pipelines.

#### **3.2 GENERAL REQUIREMENTS**

Materials shall be of the approved make and quality specified. They shall conform to the respective Bureau of Indian Standards Specifications and supported by Manufacturing Certificate.

Pipes and fittings shall be fixed truly vertical, horizontal or on slopes as required in a tidy manner.

Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.,

Pipes shall be fixed securely to walls and ceilings by suitable clamps at intervals specified. Access door for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

#### **3.3 CAST IRON PIPES AND FITTINGS**

Soil and waste pipes shall be cast iron pipes. All pipes shall be straight and smooth and inside free from irregular bore, blow hole, cracks and other manufacturing defects. Pipes shall centrifugally spun iron soil pipes conforming to I.S 3989-1984, 1729-1979.

Standard weight, dimension and pig lead required for joints shall be as follows:  
For pipes conforming to IS 3989-1984 (centrifugally spun soil pipes)

Nominal diameter		Thickness	Overall Weight6' length 1.83mm	Internal diameter of socket	Depth of lead
inches	mm	mm	kg.	Mm	Mm
2	50	3.5	8.5	73	25
3	75	3.5	12.7	99	25
4	100	4.0	19.2	126	25
6	150	5.0	35.5	178	38

**TOLERANCES**

Tolerances on the external diameter of the barrel. The internal diameter of the socket and the depth of socket shall be as follows :

Dimension	Nominal diameter mm	Tolerance
External diameter in barrel	50,57 100 150	+ 3.0 + 3.5 + 4.0
internal diameter of barrel	All diameters	+ 3.0
Depth of socket	All diameters	+ 10.0

Dimension	Nominal - Size A			
Pipe {External diameter, B {Thickness, C	50 60	75 85	100 110	150 160
{Internal diameter, F	5	5	5	5
Socket{Thickness, H {Internal depth, J	76 60	101 66	129 70	181 75
Overall length 1800mm Nominal Weight of Pipe (exclusive of ears)	kg	kg	kg	kg
Weight tolerances in all items +10%	11.41	16.52	21.67	31.92

**3.4 LAYING AND JOINTING**

*Laying and Jointing shall be as explained in Cast Iron Pressure Pipes.*

### 3.5 TESTING

The method which is commonly in use is filling the pipe with water, taking care to evacuate any entrapped air and slowly raising the system to the test pressure. The test shall be done in accordance with IS 2065 – 1983 – code of practice for water supply in buildings. The test pressure shall be 5 kg/cm<sup>2</sup> or the maximum working pressure plus 50%, whichever is greater. The pressure shall be maintained for at least 4 hours.

### 3.6 MODE OF MEASUREMENT

Cast Iron Pipes shall be measured along the center line of the pipeline including the specials in running meter (Rmt). Quoted rate shall exclude specials and the same shall be measured separately between :

- a) Chambers: Shall be recorded from the inside of one chamber to inside of another chamber.
- b) Gully trap and Chamber: Shall be recorded between socket pipe near gully trap and inside of chamber.  
The quoted rate shall include the following:
  - i) The cost of pipes and other jointing materials.
  - i) Laying, jointing and curing.
  - ii) Testing and making good the defects, if any.

### 3.7 POLYVINYL CHLORIDE (PVC) PIPES AND FITTINGS

#### 3.8 MATERIAL

**Rain water shall be PVC pipes and fittings.**

PVC (SWR) class pipes of Type A for use in rain water and conforming to IS 13592: 1992, shall be used. The pipes shall be supplied in nominal lengths of 2,3,4 or 6 meters, tolerance on specified lengths shall be +10mm and – 0mm. Any physical test requirements shall be as per IS13592-1992.

#### 3.9 HANDLING

Because of their light weight, there may be a tendency for the PVC pipes to be thrown much more. Reasonable care should be taken in handling and storage to prevent damage to the pipes. contractor should hold the fullest responsibility in this case. On no account the pipes should be dragged on the ground. Pipes should be given adequate supports at all times.

#### 3.10 LAYING

The PVC pipes shall be laid under the floors below slab or on walls either buried or exposed as the case may be. The minimum thickness of fittings shall be of 3.2 mm. the fittings shall be of injection mould type with solvent cement joint or rubber ring joint. The pipes and fittings shall be capable of withstanding sun's rays. PVC pipes laid below slab or suspended in ceiling shall be supported by angle brackets / supports . After laying and testing the pipe , the bores shall be packed and grouted with CM1:4 with water proofing compound & finish surface water tight.

### 3.11 JOINTING

The jointing of pipes to fittings shall be done as per the manufacturers instructions / recommendations.

The PVC pipes and fittings shall be joined with Solvent Cement and jointing shall be carried out as follows:

1. Cut the spigot end of the pipe square.
2. All burrs from the internal and external surfaces should be removed.
3. The spigot should be marked with a pencil line and a distance equivalent to the socket depth. Clean the surface within the marked area.
4. Apply uniform coat of solvent cement on the external surface to the pipe and a lighter coat on the internal surface of the fitting.
5. Insert the pipe end into the socket of the fitting and push it in upto the mark.

Remove the excess solvent cement and hold the joint firmly in position for 30seconds to dry. Gluing should be avoided in a rainy or foggy weather.

The other method of jointing shall be by rubber rings. The material of rubber ring should conform to IS 5382-1969. The ring is housed in groove formed in a plastic or metallic housing. The rubber is compressed and makes a seal between the pipe and housing. Lubricating paste should be applied before compressing the rubber. Where natural rubber rings are used, mineral oil or petrol or grease should be used.

### 3.12 TESTING

PVC pipes and fittings shall be tested in accordance with IS 13592 - 1992. The openings of the pipes shall be sealed for the section to be tested. The water pressure of 0.5Mpa (50.98 m of h<sub>2</sub>o or 5.98 kg/cm<sup>2</sup>) shall be maintained for a maximum of one hour. The Engineer-in-Charge shall examine carefully all the joints for leakage.

### 3.13 MODE OF MEASUREMENT

#### PVC PIPES

PVC Pipes shall be measured along the centerline of the pipeline including the specials in running meter (Rm.) between:

- a) Chambers: Shall be recorded from the inside of one chamber to inside of another chamber.
- b) Gully trap and Chamber: Shall be recorded between socket pipe near gully trap and inside of chamber.  
The quoted rate shall include the following:
  - i) The cost of pipes, specials and other jointing materials.
  - ii) Laying, jointing and curing.
  - iii) Testing and making good the defects, if any.

### 3.14 PVC PRESSURE PIPES AND FITTINGS

The PVC pressure pipes and fittings shall be used for conveying waste water from wash basins, kitchen sinks, floor drain connecting to washing machines, etc.

- 3.15 The pipes shall be class 3, 6 Kg/cm<sup>2</sup>. PVC pipes and fittings shall be jointed with solvent cement. The pipes shall conform to IS 4985. Fittings shall be of injection moulded PVC conforming to IS 7834.



**3.16 LAYING AND FIXING**

Pipes shall be cut to size and chamfered well. Burrs if any shall be removed. Pipes and fittings shall be jointed using solvent cement. The pipes and fittings shall be jointed accurately without any stress to achieve leakproof joints.

**3.17 TESTING**

The method which is commonly in use is filling the pipe with water, taking care to evacuate any entrapped air and slowly raising the system to the test pressure at 3Kg/cm<sup>2</sup>. The pressure testing may be followed as follows. The field test pressure to be imposed should be not less than the greatest of the following :

**3.18** One and half times of maximum sustained operating pressure.

**3.19** One and half times the maximum pipe line static pressure.

**3.20** Sum of the maximum sustained operating pressure and the maximum surge pressure.

**3.21** Sum of the maximum pipe line static pressure and the maximum surge pressure, subject to a maximum equal to the works test pressure for any pipe fittings incorporated.

**3.22** The field test pressure should wherever possible be not less than 2/3<sup>rd</sup> working pressure and should be applied and maintained for atleast four hours. If the visual inspection satisfies that there is no leakage the test can be passed.

**3.23 MODE OF MEASUREMENT****3.24 PVC PIPES**

PVC Pipes shall be measured along the centre line of the pipeline including the specials in running metre (Rmt) between :

- a) Chambers : Shall be recorded from the inside of one chamber to inside of another chamber.
- b) Gully trap and Chamber : Shall be recorded between socket pipe near gully trap and inside of chamber.

The quoted rate shall include the following :

- i) The cost of pipes, specials and other jointing materials.
- ii) Laying, jointing and curing.

Testing and making good the defects, if any.

**4.0 STONEWARE (SW) PIPES AND FITTINGS****4.1 MATERIAL**

Stoneware pipes and fittings shall comply with IS 651-1992 in every respect and all stoneware pipes, bends, etc., shall be of the best salt glazed variety, glazed inside as well

as outside, hard smooth, even textured, free from fire cracks, air blows and blisters. The pipe shall be truly circular in cross section, perfectly straight and of standard nominal diameter, length and depth of socket.

The pipes covered in this standard are not meant for portable water applications. The dimensions are grouped into two sections Section A&B. Section A covers dimensions of straight pipes and all such fittings which normally form part of pipeline and which are subjected to same conditions. Section B includes dimensions of fittings, which are commonly used but do not form part of the normal pipeline.

#### **4.2 LAYING**

The pipes shall be carefully laid to the levels and gradients shown in the plans and sections by making use of sight rails and boning rod and socket up the gradient.

The pipes crossing the road shall be encased in Plain Cement Concrete of 1:3:6 to the required depth. The pipes laid in the soil shall be enclosed with selected sand filling.

#### **4.3 JOINTING**

Hemp rope soaked in neat cement slurry shall be passed round the joint and inserted in it by means of caulking tool. More skins of yarn shall be added and well rammed. Cement mortar with one part of cement and one part of sand with minimum water content, but on no account soft or sloppy, shall be carefully inserted by hand into the joint & more cement mortar added until the space of the joint has been filled completely with tightly caulked mortar. The joint shall be then finished off neatly outside the socket at angle of 45 degree.

#### **4.4 CURING**

The joint shall be cured at least for seven days.

#### **4.5 TESTING**

As per IS 4127 – 1983 – code of practice for laying of glazed stoneware pipes, the pipelines and fittings shall be subjected to a test pressure of at least 2.5 m head of water at the highest point of section under test. This pressure shall be maintained for not less than 30 minutes. The contractor shall also carry out the smoke test for the drains and sewers. Any leakage will be visible & the defective part should be cut out and made good.

#### **4.6 MODE OF MEASUREMENT**

Stoneware pipes shall be measured along the centerline of the pipeline including the specials in running meter (Rm.) between:

- a) Chambers: Shall be recorded from the inside of one chamber to inside of another chamber.
- b) Gully trap and chamber: shall be recorded between socket pipe near gully trap and inside of chamber.  
The quoted rate shall include the following:
  - i) The cost of pipes, specials and other jointing materials.
  - ii) Laying, jointing and curing.
  - iii) Testing and making good the defects if any.

#### **5.0 SEWER APPURTENANCES**

**5.1 MANHOLE AND INSPECTION CHAMBERS**

Inspection chambers of Internal size 600 x 600mm upto a depth of 1.2M and manholes of varying sizes as per IS 4111 shall be constructed beyond 1.2M (depth of the sewerline from the Formation Ground level).

**5.2 LOCATION AND SIZES**

The size indicated in BOQ line item shall be the internal size of chamber. Unless otherwise specified, manholes and inspection chambers are provided at all changes of direction of drains and where branch drain meets the main drain. Chambers shall be of such size as to allow necessary examination and clearance of drains. The minimum internal sizes shall be taken as per detail drawings, standards specified and local byelaws if any. In the absence of local byelaws, the requirements stipulated in IS 4111(Part I) Code of Practice for Ancillary Structures on Sewage System shall be followed. The work shall be done strictly as per standard engineering practise and the following specifications:

**5.3 BED CONCRETE**

Bed concrete shall be in 1:4:8 cement concrete 150 mm thick for inspection chambers, 230 mm for depths upto 2.1 m and 300 mm for greater depths in case of manholes.

**5.4 BRICK MASONRY**

Brick work shall be with best quality table moulded bricks in 1:6 cement mortar as per specification for brick masonry.

**5.5 PLASTER**

Inside walls of chambers/manholes shall be plastered with 15mm thick cement plaster 1:3 mixed with waterproofing material and finished smooth with a floating coat of neat cement. External walls shall be plastered in CM 1:3 and sponge finished.

**5.6 BENCHING**

Channels and benching shall be done in cement concrete 1:3:6 rendered smooth with neat cement. The following sizes of channels for the bench shall be adopted:

Size of Drain walls	Depth of Centre	Depth at sides i.e, at walls
100 mm (4``)	150 mm (6``)	250 mm (10``)
150 mm (6``)	200 mm (8``)	300 mm (12``)

**5.7 CHAMBER/MANHHOLE COVERS**

Covers shall be of heavy duty cast iron with lifting hooks as per IS 1726 - 1974 and fixed on CI frame embedded in concrete. Covers placed on the frames shall be air tight. The height of frame and cover shall be as per bill of quantities.  
Pre cast RCC frame and cover to withstand fire truck load.

**5.8 STEPS**

CI steps duly painted shall be provided wherever the depth of the manhole/chamber is more than 1.2M. Steps shall be arranged in a staggered manner .

**5.9 DROP CONNECTIONS**

In case the difference in invert levels between the main drain and the branch line requires a drop more than 600 mm, a drop connection should be provided with a cast iron or stoneware four way junction, fixed at right angles to the drop pipe at the level where the branch pipe enters the manhole. Access for cleaning the bend should be provided at finished ground level.

**5.10 GULLY TRAP CHAMBERS**

Stoneware gully traps of specified size shall be provided as per IS 651. It shall be fixed on 15 cm. thick and 70 cm square 1:4:8 cement concrete bedding and the gully outlet shall be jointed similarly to the jointing of stoneware pipes. A brick masonry chamber 300 x 300 mm (internally) shall be constructed in 1/2 brick masonry with 1:6 cement mortar and the spaces between the trap and the wall shall be filled up with 1:3:6 concrete and the upper portion of the chamber shall be finished with neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating and the bottom of the chamber shall not be less than 230 mm. In addition to 150mm x 150mm CI grating, the chamber shall have a CI frame cover (300mm x 300 mm). It shall then be placed on top of the brick masonry.

**5.11 PVC FLOOR TRAPS**

The PVC floor trap shall be of multi-inlet and one single outlet type. The floor trap shall be deep seal type with an effective seal of minimum 50mm. The waste from sanitary fixtures shall be directly discharged to the floor trap. Jointing of the waste pipe to the floor trap shall be done as per manufacturer's instructions. The height riser fitting shall be made use of, wherever the floor drain is located in deep-sunk floors or is suspended from the ceiling. The PVC floor trap shall be of reputed makes and preferably of the same make as of the pipes used.

The floor trap shall be provided with 150 x 150mm square cast CP or stainless steel grating with rim of approved design. Minimum thickness of the grating shall be 4 to 5mm.

**5.12 MODE OF MEASUREMENT****5.13 INSPECTION CHAMBERS**

Inspection chambers shall be measured in numbers and the rate quoted shall also be per number only. The quoted rate shall include the cost of all the following items:

- a) Bed concrete.
- b) Brick work.
- c) Plastering shall be of both internal and external faces .
- d) Concrete benching channeling.
- e) Inspection chamber cover and frame including PCC bed for fixing the frame.
- f) Providing holes and embedding pipes for all connections.
- g) Excavation, refilling, necessary dewatering and disposing off extra material to a place as directed by the Engineer.
- h) Curing.
- i) Testing.

**5.14 MANHOLE**

Manholes shall be measured in numbers. The depth of a manhole shall be reckoned from the invert of the channel to the top of manhole cover. Quoted rates shall cover the range of +/- 240 mm on the depth specified and also the cost of all the following items:

- a) Bed concrete.
- b) Brick work.
- c) Plastering shall be of both internal and external faces
- d) Concrete benching and channelling including drop connections.
- e) Supply and fixing C.I. steps.
- f) Providing holes and embedding pipes for all connections.
- g) Excavation, refilling, necessary dewatering and disposing off extra material to a place as directed by the Engineer.
- h) Curing.
- i) Cost of frame and CI cover and embedding the frame in a concrete bed.
- j) Testing.

#### **5.15 GULLY TRAP CHAMBER**

Gully trap chambers shall be measured in numbers and the rate quoted shall also be per number only. The quoted rate shall include the cost of all the following items:

- a) Bed concrete.
- b) Brick work.
- c) Plastering shall be of both internal and external faces
- d) Gully trap and grating.
- e) Concrete to embed the gully trap.
- f) Chamber cover and frame.
- g) Providing holes and embedding pipes for all connections.
- a) Excavation, refilling, necessary dewatering and disposing off extra

## **6.0 WATER SUPPLY**

### **GENERAL**

#### **SCOPE**

Provide and install a complete water supply system

#### **MANUALS**

Three sets of all manuals for the systems shall be submitted to the client. This shall include instruction and maintenance manuals.

#### **AS-BUILT DRAWING**

As built drawings as specified in the contract shall be submitted to the client on completion of work.

*Drawing shall clearly show pipe routes, component details including*

**TRAINING**

It is the responsibility of the Contractor to train the Owner’s personnel in the operation and maintenance of the system.

**6.1 GI PIPES AND FITTINGS**

Pipes shall be of medium quality (Class B) galvanized iron, screwed socketed and shall conform to IS 1239. All fittings shall be malleable iron galvanized fittings of approved best Indian make. The thickness of pipes shall conform to the table given below.

The details of pipes and sockets regarding nominal bore, thickness and weight in kg/m are given in the table.

The details of pipes and sockets regarding nominal bore, thickness and weight in kg/m are given in the table.

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Nominal bore mm	Dimensions of pipes		Thick- ness mm	Dimension of Ordinary Socket		Weight of pipe length Kg/m
	Outside Diameter mm	Min. mm		Appx. ness outside diameter mm	Min mm	
15	21.8	21.0	2.65	26.90	34	1.21
20	27.3	25.5	2.65	33.70	36	1.57
25	34.2	33.3	3.25	42.60	43	2.42
32	42.9	42.0	3.25	51.00	48	3.11
40	48.8	47.9	3.25	57.00	48	3.59
50	60.8	59.7	3.65	70.00	56	5.07
65	76.6	75.3	3.65	88.90	65	6.49
80	89.5	88.0	4.05	101.60	71	8.43
100	115.0	113.1	4.50	122.00	77	12.04

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The following manufacturing tolerance shall be permitted on tubes and sockets in addition to those indicated in the table above.

**a) TUBE**

**1 THICKNESS**

- i) Medium tubes butt welded : + Not limited - 10 percent
- ii) Medium tubes seamless : + Not limited - 12.5 percent

**2 WEIGHT**

- i) For quantities of 150m and over, (one size) : +/-4 percent
- ii) Single tube : + 10 percent  
3 percent
- b) **SOCKETS**  
Outside diameter : +/- 2.5 percent

**6.2 LAYING AND FIXING**

Where pipes have to be cut or re-threaded, ends shall be carefully filed so that no obstruction to the bore is offered. For internal work all pipes and fittings shall be fixed truly vertical and horizontal, either by means of standard pattern holder bat clamps keeping the pipes 1/2" (12mm) clear of the wall everywhere or concealed as directed. For external work, G.I. pipes and fittings shall be laid in trenches. The width of the trench shall be the minimum width required for working. The pipes laid underground shall be not less than 60cm. from the finished ground level and a minimum horizontal distance of 60CM shall be maintained between other services lines.

**6.3 WRAPPING OF CONCEALED GI PIPES****Cleaning**

Pipe surfaces shall be thoroughly cleaned and dried before tape is applied and shall be free of dirt, grease and rust scale or other foreign matter. The pipe shall be cleaned mechanically.

Oil and grease, if present on the pipe surface should be removed by using a suitable solvent and clean rags. The use of dirty, oily rags should not be permitted.

**Disinfection of the pipe network**

The entire water distribution network is to be disinfected by using residual chlorine of 0.2 ppm for a period of 2 (two) hours. The entire chlorinated pipe network is to be flushed out with fresh water before the water supply system is put into operation for domestic usage.

**Field Application of tape**

The tape shall be wrapped in accordance with the manufacturers recommendations in a manner that shall meet the adhesion requirement. During application, care shall be taken to ensure that there are no air pockets or bubbles beneath the tape.

The tape should be wrapped with an overlap of 50% for TEES. The first wrapping shall be done individually. The tape may be cut if required to suit the profile. There shall be two layers of tape wrappings. The first layer is to be wrapped on the pipe directly after cleaning the pipe surface. The second layer is to be applied over the first layer. The second layer should also be wrapped with 50% overlap.

**6.3.1 COLOUR CODE FOR WATER SUPPLY PIPES**

Colour code for water supply pipes shall be as per standard requirement. Details are as mentioned below.

**COLOUR CODE FOR GENERAL SERVICES**

SL NO	DESCPRITION	GROUND COLOUR	FIRST COLOUR BAND	SECOND COLOUR BAND
<b>A</b>	<b>WATER</b>			
1.0	Cooling	Sea green	French blue	-----
2.0	Boiler feed	Sea green	-----	-----
3.0	Condensate	Sea green	Light brown	-----
4.0	Drinking	Sea green	French blue	Signal red
5.0	Treated	Sea green	Light orange	-----
6.0	Cold water from storage tank.	Sea green	French blue	Canary yellow

**6.4 HOT WATER PIPE INSULATON**

Hot water pipe shall be insulated with elastomeric light weight flexible thermal insulation in the form of tubes. The density of material shall be 60-100 Kg/m<sup>3</sup> and thermal conductivity at 20°C shall be 0.0340 W/M<sup>0</sup> K. The thickness of the tubing shall be 6mm and the joints shall be covered with self adhesive tape. The material shall be as manufactured by M/s. Polybond (Vidoflex).

**6.5 TESTING**

Before any pipes are painted or covered, they shall be tested to a hydrostatic pressure of 7kg/sqcm. or twice the working pressure of the pumping main whichever is lighter. Pressure shall be maintained for at least eight hours without an appreciable drop in pressure. In addition to the sectional testing of water supply pipes, the contractor shall test the whole installation to the entire satisfaction of the Engineer in charge. He shall rectify any leakages, failure of fittings or valves.

**6.6 MODE OF MEASUREMENT**

G.I. pipes above ground shall be measured along the centre line of the pipes and fittings. The quoted rate for respective item shall be per Rmt and shall include the following:

- a) Cost of respective pipes and specials.
- b) Laying, fixing and jointing with standard pipe clamps available for different sizes inside the wall chase and fixed on MS angle iron brackets and GI U clamps for pipes in ducts as shown on the drawing.
- c) Cutting holes and chases in walls, floors, etc. and making good the same.
- d) All supporting arrangements, brackets, etc.
- e) Testing and making good the defects, if any. G.I. pipes below ground shall be measured as stated elsewhere in the specifications.

**6.7 PVC PRESSURE PIPES AND FITTINGS**

Pipes shall be schedule 40 PVC pipes screwed socketed and shall conform to ASTM D-1785. The fittings shall be of the same material threaded or malleable iron galvanised fittings of approved make. The pipes shall be of blue colour.

**6.8 LAYING AND FIXING**

Pipes shall be cut to size and threaded with a standard GI threading die. The pipe and fitting shall be jointed using teflon tape as thread sealant. The pipe and fittings can be



tightened by hand also to achieve a leak proof joint. Pipes shall be fixed by means of holderbat clamps keeping the pipes 12mm away from the wall for easy maintenance. Pipes running on the roof slab shall be suitably supported by support blocks and protected from or treated for ultra violet radiation.

#### **6.9 TESTING**

Pipes shall be tested to a hydrostatic pressure of 10kg/sq cm. and the pressure shall be maintained for atleast eight hours without an appreciable drop in pressure. In addition to the sectional testing of water supply pipes, the contractor shall test the whole installation to the entire satisfaction of the engineer in charge.

#### **6.10 MODE OF MEASUREMENT**

PVC pipes shall be measured along the centre line of the pipes and fittings. The quoted rates are per meter length.

- a) Cost of respective pipes and specials
- b) Laying, fixing and jointing with necessary clamps.
- c) Cutting holes and chases in walls, floors, beams etc., and making good the same.
- d) All supporting arrangements, brackets, etc.,
- e) Testing and making good the defects, if any. GI pipes below ground shall be measured as stated elsewhere in the specifications.
- f)

#### **6.11 VALVES, STRAINERS AND PRESSURE GAUGES**

##### **6.11.1 GENERAL**

This section deals with different type of valves like butterfly valves, gate valves, ball valves, check valves, balancing valves and Strainers and pressure gauges. The contractor shall refer to the approved make of materials specified in the document.

Valves shall be provided on branch pipe connections to mains and at connection to equipment where indicated. All valves are to be located for easy access. All valves shall be supported wherever necessary with MS brackets. Valves shall comply with IS 780 (Class I) for C.I sluice valves and IS 778 for G.M valves and tested.

Pressure gauges shall have outer diameter not less than 115mm with 10mm BSP full thread, brass body syphon and gauge cock of size10mm. Dial gauges shall have adequate response for the pressures encountered within the specified (Range 0-15Kg/sq.cm).

##### **6.11.2 GATE VALVE**

The primary function of a gate valve is for starting and stopping of flow. It has a disc actuated by a stem screw and hand wheel, moves up and down at right angles to the path of flow of fluid and seats against two faces to shut of flow. As the disc of the gate valve presents a flat surface to the direction of flow, this valve is only for starting and shutting the flow in the pipe.

These valves are of GM make. Supplying, fixing and testing correspond to IS 778-1984, Specifications for Copper Alloy Gate, Globe and Check Valves for Water Works.

All globe and check valves shall have working parts suitable for hot and cold water, as required. Valves shall be tagged with permanent label under hand wheel indicating type or duty.

All valves should have manufacturer's test certificate indicating the date of shop test and other quality control tests with the material used for the same. Gate valves shall be of the size as specified in the BOQ.

Also the following standard corresponds to their manufacture.

Design	-	API600/BS1414
Face to Face/End to End	-	ANSI B 16.10
Flange Dimension	-	ANSI B 16.5
Butt Weld Ends	-	ANSI B 16.25
Pressure/Temperature Ratings	-	ANSI B 16.34
Testing	-	API 598

### 6.11.3 BALL VALVE

The ball valve shall be of high-pressure type and shall be of sizes as specified in the BOQ. The normal size of a ball valve shall be that, corresponding to the size of the pipe to which it is fixed. Ball valves shall have body of carbon steel. The ball and the shaft shall be of stainless steel. The seat shall be of PTFE. The valve shall be complete with socket weld ends and the float of copper sheet. The minimum thickness of copper sheet used for making the float shall be 0.45mm for a float exceeding 115mm dia. The body of the high-pressure ball valve when assembled in working condition with the float immersed to not more than half of its diameter shall remain closed against a test pressure of 3.5kg/sqcm.

The ball valve shall generally conform to IS specification No.1703:1977. The weight of ball cock and the size of the ball cock shall be as per IS specification.

### 6.11.4 FOOT VALVES

Foot valves are provided with cast iron body with brass disc and strainer of approved quality as specified in BOQ. The foot valve shall be of spring loaded or flapper type depending on the requirement. The valves should be tested physically for free operation before being mounted or assembled to the pipeline.

### 6.11.5 BUTTERFLY VALVES

Butterfly valves shall be slim seal, short wafer type with standard finish. The valves shall be suitable for mounting between flanges drilled to ANSI 125. The valve body shall be cast iron. The disc shall consist of disc pivot and driving stem shall be in one piece centrally located. The disc shall move in bearings on both ends with 'O' ring to prevent leakage. The seat shall be moulded with black nitrile rubber or nylon and shall line the whole body. The spindle shall be AISI 41 steel. The valve shall be suitable for a working pressure of 16.5 kg/sq.cm and shall be complete with flow control lever and notches, factory machined companion flanges and bolts and nuts. These valves conform to BS 5155 with electro steel nickel coated SG Iron (N) and seat material EPDM3.

Also the following standard corresponds to their manufacture

Design	-	API609/BS5155
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Face to Face/End to End	-	ANSI B 16.10
Flange Dimension	-	ANSI B 16.5
Butt Weld Ends	-	ANSI B 16.25
Pressure/Temperature Ratings	-	ANSI B 16.34
Body	-	Heavy duty CI to IS210 Gr FG220 & BS 1452
Seating	-	moulded insitu resilient lining of black nitrile rubber.
Disk	-	Nylon coated SG iron of IS 1865/SF400/127BS2729 Gr. 420/12
Shaft	-	shafts are to be made of SS AISI 431 Only, flanged valves to be used with Flanges drilled to BS10 table F, valves shall be capable of being locked in open Position. Hand wheel shall be with Worm and worm wheel operated for Smooth opening and closing. Key rod with MS Coated extended spindle to be provided wherever the valves are not approachable from the ground surface.

#### 6.11.6 CHECK VALVES

Check valves are designed to prevent reversal of flow. These are also called Non-return valves or reflux valves to avoid reversal of flow. Check valves shall be Dual Plate check valves with CI body, aluminium bronze plate SS 316 hinge pins and springs and Buna-N seals to ANSI series 125. They can also conform to IS 778-1984, Specifications for Copper Alloy Gate, Globe and Check Valves for Water Works.

Also the following standard corresponds to their manufacture

Design	-	BS1873/IS 5312 Part I
Face to Face/End to End	-	ANSI B 16.10
Flange Dimension	-	ANSI B 16.5
Butt Weld Ends	-	ANSI B 16.25
Pressure/Temperature Ratings	-	ANSI B 16.34

#### 6.11.7 STRAINERS

“Y” strainers up to 50mm shall be of gunmetal and above 50mm shall be of cast iron body. Strainers shall incorporate a removable bronze screen with 3.175mm (1/8”) perforations and a permanent magnet. Strainers shall be provided with flanges at both inlet and outlet. They shall be designed to enable blowing out of accumulated dirt and facilitate dirt and facilitate removal and replacement of the screen without disconnection of the main pipe.

All strainer shall be provided with equal size isolating “Slim Seal” butterfly valves of approved brands so that the strainer may be cleaned without draining the system

#### 6.11.8 FLANGES AND UNIONS

Sufficient number of flanges and unions shall be provided as required to facilitate maintenance work after the piping is installed. Mild steel flanges shall be used for pipes.

The flanges shall be connected to the pipeline by screwing or welding depending on the requirement. The flanges shall conform to the relevant ASTM standard for the particular material used for its manufacture. The flanges shall also conform to IS 5211.

**6.11.9 PRESSURE REDUCING VALVE**

Pressure relief valves are provided to keep the pressure in the line below a given value within the reasonable limits in the downstream side of the pipeline when the pressure builds up beyond the design value. Pressure reducing valves shall be of high-pressured type of specified sizes. The valves should be suitable for mounting between flanges and threading connections also. The valve body shall be of bronze / SS as specified. The valve shall be of spring loaded, direct operation, metallic diaphragm type, as required for the particular usage.

The pressure reducing valves should be manufactured in conformance with ASA-150,300,600,800,900 and 1500, or to BS10- table –D,E,F,H or DIN- ND-16 & ND-40.

**6.11.10 BRASS BIB COCK AND STOP COCK**

A bibcock is a draw off tap with a horizontal inlet and free outlet and stop cock (stop tap) is a valve with a suitable means of connections for insertion in a pipeline for controlling or stopping the flow. They shall be of specified size and shall be screw down type. The closing device should work by means of a disc carrying a renewable non-metallic washer, which shuts against water pressure on a seating at right angles to the axis of the threaded spindle, which operates it. The handle shall be either crutch or butterfly type securely seated pattern. The cocks (taps) shall open in anticlockwise direction.

The bibcock and stopcock shall be polished bright (Chrome plated). The minimum finished weights of bib tap (cock) and stop tap (cock) as given in the IS specification are reproduced in the table:

Size Mm	Minimum finished weight	
	Bib tap kg.	Stop tap Kg.
8	0.25	0.25
10	0.30	0.35
15	0.40	0.40
20	0.75	0.75

**6.11.11 LEVEL SENSORS**

Level sensor shall consist of control unit, preamplifier and one full insulated probe-mounted vertically or two part insulated probe mounted from tanks side wall adjustable switching system for pump control application, the same to be housed in stove enamel painted cast aluminium weather proof suitable for black panel / wall mounting etc.,

The enclosure of probes shall be manufactured with SS316 material. The least count of the central unit with amplifier should be +/- 0.10mm for response value of 30 seconds.

**6.11.12 LEVEL INDICATORS**

A level control system with electronic level probes is mounted on the face of the reservoir. The top two level sensors provide the ON-OFF signal for the treated water

transfer pumps. A third level sensor enunciates a low level alarm condition to the paging system and a fourth sensor enunciates an alarm to the paging system and stops the domestic water pumps from operating.

#### **6.11.13 ANTI FLOOD NON-RETURN VALVES FOR SEWERAGE CONNECTION**

These valves are used for eliminating flood risk from the sewerage system. These valves should conform to the Building Regulations (H1- A13) and British standard BS 8301-1985. The valve should suit every angle without restricting the internal cross-section of the pipe. The valves shall be suitable for maintenance in accordance with CDM regulations, 1994. The valve is to be installed in level. For valves installed for depths more than 1 metre require brickwork or concrete construction in accordance with BS 5955- Part6 – 1980. The valve is to be suitable installed as per the manufacturer's instruction.

#### **6.11.14 RELIEF VENTS**

Drainage systems, especially those in tall buildings, are frequently found to develop extremely high and objectionable pneumatic effects in several specific portions of such piping. Special air pressure relief vents are recommended to control, within tolerable limits.

The air pressure relief vent, at least one-half the diameter of the building drain, should be provided at the top of vertical offset so as to supply such additional air to the drain as may be required by the sudden increase in liquid velocity in the vertical offset. Where a building trap or other sharp change in flow direction is provided in the building drain downstream from the vertical offset, an air pressure relief vent should be provided at the base of, and within 3 ft (0.900m) of, the vertical offset. Lower relief vent should be branch connected to the upper relief vent at a sufficient height.

The recommended provision for soil and waste stacks more than ten stories in height is to provide yoke relief vent at each tenth story of the drainage stack, counting downward from the top story. The lower end of the yoke relief vent should connect to the drainage stack by means of a Y located below the horizontal branch drain serving fixtures in that story, and the upper end should connect to the vent stack by means of a T or inverted Y located at least 3 ft (0.900m) above the floor level .

#### **6.11.15 INSTALLATION OF VALVES**

Valves should be installed in true tolerance of +/-5mm with respect to the centre line of the pipe. Where threaded joints are encountered the threads should be initially sealed with PVC tape to avoid leakage due to improper tightening and leakage from threading.

Proper care has to be taken in welded installation so that the centreline of valve should not deviate from the pipe causing uneven load on the pipe and further stress during its operation. The welding should be done only after proper inspection of the joint by the Engineer-in-charge in the tacked position of the joint.

Before putting the line in operative mode the valves should be checked for free and easy operation of the hand wheel. Any burrs or foreign materials should be removed by flushing before final operation so that no choking in the valves should occur which might damage the valve seating.

#### **6.12 MODE OF MEASUREMENTS**

Valves shall be measured in number only and the cost shall include :

- a) Cost of valves and jointing materials.
- b) Fixing and jointing with necessary bolts, nuts, rubber inserting, etc.

Testing and making good the defects if any.

### 6.13 WATER HAMMER ARRESTORS

The effective fluid hammer which result in breaking of pipeline caused due to series of hydraulic shock should be arrested by means of a water hammer arrestor. The arrestor shall be capable of withstanding pressures upto 500 P.S.I. and temperatures in the range of  $-40^{\circ}\text{F}$  to  $212^{\circ}\text{F}$  (  $-54^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$ ). It shall be maintenance free with a companion flange to suit in the pipeline. The following materials are used for its manufacture

Barrel	—	Type 'K' hard drawn copper
Cap	—	Standard wrought copper fittings attached to Barrel with 95-5 solder.
Piston & Thread Adaptor	—	Machined of free turning brass.
Seals	—	"O" rings shall be of Parker spec. EP-5778-80
Seal Lubricant	—	Dow-corning silicone compound #111, FF & DA Listed for use in potable water system or Nickel plated for sea water application.

### 6.14 LAWN HYDRANTS

Lawn hydrants shall be 2.5cms. unless otherwise indicated. All hydrants shall be provided with gate valves that are screwed faucet to receive hose pipes. Lawn hydrants shall be of approved make and design. Where called for, lawn hydrants shall be located in brick masonry chambers of appropriate size as per specifications given herein after.

### 6.15 BRASS FULL WAY VALVE

Full way valve is a valve with suitable means of connection for insertion in the pipe line for controlling or stopping the flow. The valve shall be of brass, fitted with a cast iron wheel and shall be of gunmetal gate valve type opening full way of the size as specified. The valve shall be of best quality or approved by the Engineer-in-charge.

### 6.16 GUNMETAL FULL WAY VALVE WITH WHEEL

These shall be of gun metal fitting with wheel and shall be of gate valve type opening full way and of the size as per specification. These shall generally conform to IS 7780-1984. All globe & check valves shall have working parts suitable for hot & cold water, as required. Valves shall be tagged with permanent label underhand wheel indicating type or duty.

### 6.17 FOOT VALVES

Provide cast iron body with brass disc and strainer of approved quality, wherever shown.

**6.18 MODE OF MEASUREMENTS**

Valves shall be measured in number only and the cost shall include :

- a) Cost of valves and jointing materials.
- b) Fixing and jointing with necessary bolts, nuts, rubber inserting, etc.
- c) Testing and making good the defects if any.

**7.0 SANITARY INSTALLATION AND FIXTURES****7.1 GENERAL**

All fixtures shall be fixed in a neat workman like manner true to line and as recommended by the manufacturer. Care shall be taken to fix all fixtures, brackets and accessories by proper wooden cleats, rawl plugs, bolts and nuts.

**7.2** Care shall be taken in fixing all approved chromium plated (CP) fixtures and accessories so as not to leave any tool marks or damages on the finish. All such fixtures shall be tightened with fixed spanners. Use of 'Stiltson' type pipe wrenches with toothed jaws shall not be allowed.

**7.3** All fixtures shall be thoroughly tested after connecting the drainage and water supply system. All fixtures shall be thoroughly finished and any leakage in piping, valves and waste fittings corrected to the entire satisfaction of the Consultant/Engineer.

**7.4** Upon completion of the work, all labels, stickers, plasters, etc. shall be removed from the fixtures and all fixtures shall be cleaned with soap and water so as to present a neat and clean toilet.

**7.5 INDIAN WATER CLOSET**

Indian Water Closet Orissa pan type with 'P' or 'S' trap shall be provided with Polypropylene cistern with necessary accessories etc., as per BOQ. Indian Water Closet and trap shall be set in plain cement concrete 1:4 and flush with the floor.

**7.6 MEASUREMENT**

Indian Water Closets shall be measured per number and the quoted rate shall include :

- a) The cost of W.C. pan with 'P' or 'S' trap and cistern.
- b) Setting the closets in Plain cement concrete including the cost of cement concrete.

**7.7 EUROPEAN TYPE WATER CLOSET**

The closet shall be of white or coloured (as per BOQ) vitreous China Floor mounted type and shall be of the best quality manufactured by an approved firm, and fixed by approved means. It shall have 100 mm dia porcelain `P` or `S` trap depending on the location of water closets and soil stacks with effective seal. Each closet shall be provided with the following accessories:

- a) Double flapped heavy urea formaldehyde seat cover of approved make quality and colour with rubber buffers and C.P. brass screws fixed to the pan.
- b) Flushing cistern complete with internal fittings
- c) 15mm C.P health faucet with angle valve.

**7.8 MODE OF MEASUREMENT**

These items shall be measured in numbers and the rate quoted shall be per number only. The quoted rate shall include.

- a) The cost of W.C. pan and flush cistern
- b) Plastic seat cover.
- c) Jointing and fixing material.

**7.9 WASH BASINS**

They shall be of white or colored (as per BOQ) vitreous China best quality manufactured by an approved firm and size as specified. They shall be supported on a pair of C.I. brackets of approved design.

Each washbasin shall be provided with 1 no. CP 15mm dia basin mixer /pillar cock(as per BOQ), 15mm CP brass stopcocks, 8mm CP inlet pipe, 32mm CP waste coupling, 32mm CP bottle trap with extension pipe unless otherwise specified.

**7.10 MODE OF MEASUREMENT**

These items shall be measured in numbers and the rate quoted shall be per number only. The quoted rate shall include:

- a) The cost of washbasin with brackets and other items stated.
- b) Jointing and fixing materials.
- c) Painting of brackets.

**7.11 SHOWER UNIT**

The shower unit shall be brass chromium plated wall mounted unit with CP spout and diverter. The shower unit shall be fitted with an over head shower set comprising of shower arm, rose etc., complete with wall flange.

**7.12 MODE OF MEASUREMENT**

All the items above shall be measured in numbers only and the quoted rate shall be per number, which shall include:

- a) The cost of respective materials.
- b) Necessary fixtures.



- c) Fixing in position and
- d) Testing where necessary/specified.

**7.13 SINKS**

They shall be Stainless steel of best quality and shall be supported on necessary brackets. Each sink shall be provided with 40 mm CP waste coupling, CP bottle trap, hot and cold sink mixer / sink cock as per BOQ.

**7.14 MEASUREMENT**

Sinks shall be measured in numbers including all items stated above and shall include the cost of all fixing materials and fixing in position.

**7.15 URINAL**

Urinal shall be white or colored as per Bill of Quantities. The urinal shall be large flat back type fixed with hanger and brackets. Others shall supply the partition. Each urinal shall be provided with electronic auto flushing system with infrared sensor, solenoid valve, gate valve and housing box. The wiring and conduit shall be considered along with the system. Each urinal shall be provided with the following units.

- 40 mm dia. C.P waste coupling with dome grating.
- 40 mm dia. C.P bottle trap.
- C.P urinal spreader & C.P flush pipe.

**7.16 MEASUREMENT**

Urinal shall be measured in numbers including all items stated above and shall include the cost of all fixing materials and fixing in position.

**8.0 TOILET ACCESSORIES****8.1 MIRROR**

Mirrors shall be of the best quality and of approved make, 6.0 mm thick with copper backing fixed to 8mm thick commercial plywood fixed to the back of the mirror and encased with teakwood frame. The mirror shall be fixed to wall with stainless steel screws.

**8.2 TOWEL RAIL**

Towel rail shall be of C.P. with reinforced bends and circular flanges. The size of the rail shall be as specified. The bracket shall be fixed by means of stainless steel screws to wooden/plastic cleats firmly embedded in the wall.

**8.3 TOILET PAPER HOLDER**

Toilet paper holder shall be of chromium plated as specified in the B.O.Q.

**8.4 TOWEL RING, SOAP TRAY, ETC.**

These shall be of CP specified in the bill of quantities. These shall be fixed by means of stainless steel screws to wooden / plastic cleats firmly embedded in the wall.

**8.5 ELECTRIC HAND DRIER**

The electric hand drier shall be twin blower type interpreted with timer range 0 to 3 minutes. The drier shall be fully automatic. The power requirement shall be 230V, 1PH, 50Hz 1700 watts. The drier shall be wall-mounted type.

**8.6 SOAP DISPENSER**

The Soap dispenser shall be wall mounted type tough ABS plastic with soap pouch and pump system as manufactured by M/s. Kimberly - clark. The capacity of dispenser shall be 500 litres.

**8.7 MODE OF MEASUREMENT**

All the items above shall be measured in numbers only and the quoted rate shall be per number, which shall include:

- a) The cost of respective materials.
- b) Necessary fixtures.
- c) Fixing in position and
- d) Testing where necessary/specified.

**9.0 ELECTRIC WATER HEATER**

**9.1** Hot water heaters where specified shall be pressure type controlled outlet, wall mounted horizontal/vertical type of suitable capacity given in the Schedule of Quantities. Hot Water heaters shall have copper container duly tinned and 75mm thick fiberglass insulation. The jacket shall be M.S. steel white stove enamelled finish. The heater shall conform to I.S.2082-1965. Each heater shall be thermostatically controlled with a pilot neon lamp.

**9.2** Hot water heaters shall be installed true to level in a neat workmanlike manner. Wall hung heaters shall be fixed with nuts and bolts of ample size neatly grouted in the wall and finished with cement concrete packing.

**9.3** Each heater inlet and outlet shall be connected by means of a 20mm dia C.P. copper tubing with necessary nuts and washers. One 20mm dia C.P. brass stopcock and C.P. horizontal or vertical non-return valve shall be provided on the inlet. If the inlet and outlet connections to the hot water heater are 15mm or less, the connection to C.P. pipes described above shall be made by a C.P. Reducer. Bushes shall not be used.

**10.0 PUMPS**

**10.1** Pumps shall be horizontal centrifugal monobloc pumping sets.

**10.2** Pumps shall be cast iron with dynamically balanced and consist of a gunmetal impeller and stainless steel shaft. The bearing shall be grease lubricated ball type.

**10.3** The motor shall be squirrel cage, totally enclosed fan coded induction type suitable for 400/440 volts, 3 phases, 50 cycles AC supply. The winding shall be specially insulated with class 'E' materials and impregnated to exclude moisture. The performance of the motor shall be conformed to IS 325.

**10.4** The frame and base for the pumping set shall be cast iron, drip and splash proof and shall incorporate both the pump and motor.

- 10.5** Each pump shall be provided with a 10mm dia dial type pressure gauge, gunmetal isolation cock and connecting piping. The gate and check valves on suction and delivery side of the pump shall be measured under the item Valves.
- 10.6** Each motor shall be provided with a switchboard cubicle of approved type fabricated from 18 gauge MS sheet and finished with synthetic enamel paint of approved shade. The cubicle shall comprise of the following:
- Incoming main switch fuse unit of required capacity.
  - Fully automatic dot starter suitable for motor HP with push button (one for each motor)
  - Single phase preventer
  - Panel type ampere and voltmeter (one for each motor in case of two motors)
  - Pilot lamps for phase indicating.
  - Rotary switch for manual/auto operation.
  - All inter connecting wiring from incoming main to switch gear, meters and accessories with color code)
- 10.7** Switch board cubicle shall be floor or wall mounted type as approved. The contractor shall provide cables from switchboard cubicles to the electric motor. The cables shall be PVC sheathed cables of required size and capacity.
- 10.8** Pumps shall be installed true to level on suitable concrete foundations. Base plate shall be firmly fixed by foundation bolts properly grouted in the concrete instrument. Manufacturer's instructions shall be followed for installation and commissioning of the pump set and electrical panel.
- 10.9** Pump sets shall be measured by number and shall include all accessories mentioned in the above specification.

## **11.0 STORM WATER DRAINAGE**

### **11.1 SCOPE OF WORK**

Work under this section consists of furnishing all labor, materials, equipment and appliances necessary and required to completely install drainage system as specified herein after and given in the schedule of quantities.

Without restricting to the generality of the foregoing, the drainage system shall include the following: -

- Vertical and Horizontal Cast Iron pipes and fittings, joints, clamps and connections to fixtures
- RCC Hume pipes (light duty pressure pipes)
- Connection of all pipes to Catch Basins.
- Floor traps cleanout plugs and inlet fittings.
- Testing of all pipes lines.

### **11.2 REINFORCED CEMENT CONCRETE (RCC) LIGHT DUTY PIPES.**

These pipes shall conform to IS 458-1988. This shall be of class Non Pressure (NP2). The design and strength thickness and test requirements of pipes shall be as per table 2. of IS 458.

**11.3 LAYING AND JOINTING**

The concrete pipe should be carefully loaded, transported and unloaded without impact, the laying of pipes shall be done by using tripod stand and chain pulley blocks. The pipe trench width shall be as per clause no. 2.10.

Joints shall be of collar joint and the caulking space shall be filled with CM. 1:1 mixture of cement & sand. The caulking shall be employed on both the ends and finished neatly outside the socket at an angle of 45°. Wooden caulking tool shall be used for forcing the mortar home into the collar.

All the joints shall be kept moist by means of wet gunny cloth to protect them from quick drying. The joints shall be cured at least for seven days.

**11.4 TESTING**

Testing of non pressure pipes shall be subject to a test for 2.5 meters head of water at the highest point of the section under test for 10 minutes. The leakage or quantity of water supplied during testing shall not exceed 0.2 lt./mm dia of pipes per Km length per day.

**11.5 CATCH BASIN**

Catch Basins of Internal size 450 x 450mm upto a depth of 0.75M and manholes of varying sizes as per IS 4111 shall be constructed beyond 1.2M (depth of the storm water from the Formation Ground level/ finished floor level).

**11.6 LOCATION AND SIZES**

The size indicated in the BOQ line items shall be the internal size of catch basin chamber. Unless otherwise specified catch basins are provided at all change in directions of drains and where branch drain meets the main drain. Catch basin shall be of such size as to allow necessary examination and clearance of drains. The minimum internal sizes shall be taken as per standards specified and as per local bye laws if any. In the absence of local byelaws, the requirements stipulated in IS 12251 shall be followed. The work shall be done strictly as per standard drawings and the following specifications:

**11.7 BED CONCRETE**

Bed concrete shall be in 1:4:8 cement concrete 230mm thick for catch basins.

**11.8 BRICK MASONRY**

Brick work shall be with best quality table moulded bricks in 1:6 cement mortar as per specification for brick masonry.

**11.9 PLASTER**

Inside walls of catch basin shall be plastered with 15mm thick cement plaster 1:3 mixed with waterproofing material and finished smooth with a floating coat of neat cement. External walls shall be plastered in CM 1:3 and sponge finished.

**11.10 BENCHING**

Channels and benching shall be done in cement concrete 1:3:6 rendered smooth with neat cement.

The following sizes of channels for the bench shall be adopted:

Size of Drain	Depth of Centre	Depth at sides i.e, at walls
---------------	-----------------	------------------------------

100 mm (4`)	150 mm (6`)	250 mm (10`)
150 mm (6`)	200 mm (8`)	300 mm (12`)

### 11.11 CI GRATING FOR CATCH BASIN COVER

Gratings shall be of heavy-duty cast iron with lifting hooks as per IS 1729/79 on top surface and fixed on CI frame embedded in concrete. The weight of frame and cover shall be as per bill of quantities.

### 11.12 STEPS

PVC rungs shall be provided wherever the depth of the catch basin is more than 1.2M. Steps shall be arranged in a staggered manner.

### 11.13 DROP CONNECTIONS

In case the difference in invert levels between the main drain and the branch line requires a drop more than 600 mm, a drop connection should be provided with a cast iron junction, fixed at right angles to the drop pipe at the level where the branch pipe enters the catch basin. Access for cleaning the bend should be provided at finished ground level.

### 11.14 MODE OF MEASUREMENT

The measurement of the storm water drainage is done as given below the excavation of trenches for laying of light duty RCC pipe (hume pipe) the excavation for drainage, refilling in proper way as per the standard are measured in terms of cubic. Meters

The laying and jointing of pipe is measured in terms of running meters (Rm.) from center line of one collar to the center line of next collar.

Catch basins and gully traps are measured in terms of Nos. (number of quantities).

## 12.0 CAST IRON PRESSURE PIPES

### SCOPE

This specification covers the method of laying cast iron pipes below ground level for drainage works. The specification includes:

- (1) Specification for pipes and fittings
- (2) Laying
- (3) Jointing
- (4) Hydrostatic testing of pipes

The cast iron pipes used for the work shall conform to the following standards IS 1537 – 1976 – Specification for vertically cast iron pressure pipes for water, gas and sewage. Class LA IS 6163 – 1978 – Specification for centrifugally cast ( spun ) iron low pressure pipes for water, gas and sewage IS 1538 ( part 1 to 23) – 1976 – Specification for cast iron fittings.

### 12.1 TOLERANCES

Tolerance in millimeters on external, internal diameter and depth of socket.

For class LA

External diameter of barrel

+ 1/3 f to – ½ f

Internal diameter of socket	+ 1/3 f to - ¼ f
Depth of socket	+/- 5 mm
For low pressure pipes	
External diameter of barrel	+/- ½ f or +/- (4.5+0.0015 DN)
Internal diameter of socket	+/- ½ f or +/- (3+0.001DN)
Depth of socket upto and including 600mm	+/- 5 mm
For fittings	
External diameter of barrel	+/- ½ f or +/- (4.5+0.0015DN)
Internal diameter of socket	+/- 1/2 f or +/- (3+0.001DN)
Depth of socket upto and including 600mm	+/- 5 mm
where f is the caulking space of the joint in millimeters and is equal to 9+0.003 DN and DN is nominal diameter in millimeters.	
Tolerance in millimeters on thickness	
For class LA	
Wall thickness	- ( 1 + 0.05 e )
Flange thickness	+/- ( 2 + 0.05 b )
For low pressure pipes	
Wall thickness	- ( 1 + 0.05 e )
Flange thickness	+/- ( 2 + 0.05 b )
For fittings	
Wall thickness	- ( 2 + 0.05 e )
Flange thickness	+/- ( 3 + 0.05 b )
Where b and e are standard thickness of wall and flange respectively in millimeters	
Tolerances in millimeters on lengths	
For class LA	
Socket and spigot, and plain ended pipes	+/- 20mm
For flanged pipes	+/- 10mm
For low pressure pipes	
Socket and spigot, and plain ended pipes	+/- 25mm
For fittings	
Socket fittings and flange	
And spigot pieces upto and including	
Nominal diameter of 450mm	+/- 20 mm
For flange fittings of all diameters	+/- 10mm

## 12.2 CLEANING OF PIPES AND FITTINGS

All lumps, blisters and excess coating shall be removed from the socket and spigot end of each pipe and the outside of the spigot and the inside of the socket shall be wire-brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

### **12.3 CLOSING THE ENDS OF PIPE TO PREVENT ENTRY OF FOREIGN MATERIALS WHILE LAYING PIPE**

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipe laying team cannot put the pipe into the trench and in place without getting earth into it, the Engineer-in-charge may order a heavy tightly woven canvas bag of suitable size be placed over each end and left there until the connection is to be made to the adjacent pipe that before lowering the pipe into the trench. During laying operations, no debris, tools, clothing or any other material shall be placed in the pipe. After laying and jointing of a reach is completed the two free ends shall be kept closed to prevent entry of foreign materials, rodents and other animals.

### **12.4 CUTTING OF PIPE**

The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workman like manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. For this purpose use of a pipe cutter is recommended. Pipe cutting machines are recommended for large pipes. When pipe-cutting machines are not available for cutting pipes of large diameters, the electric arc cutting method may be permitted using carbon or steel rods.

Only qualified and experienced workmen shall be employed on this work. When the pipe-cutting machine is not available and the site conditions do not permit pipe cutting by machine, the pipe can be cut using a chisel. Flame cutting of pipes by means of ox-acetylene torches shall not be allowed.

### **12.5 DIRECTION OF LAYING OF SOCKET END**

On level ground, the socket ends should face the upstream. When the line runs uphill the socket ends should face the upgrade.

The permitted tolerance for deflection for lead joint shall be 2.5 millimeters.

### **12.6 JOINTING**

Jointing of socket and spigot pipes is done by molten lead ( under dry conditions ) and lead wool joints.

### **12.7 MOLTEN LEAD JOINTS**

Pig lead - for jointing purposes should conform to IS- 782-1978. Spun yarn used, as jointing material shall be of sterilized quality. It should have been exposed to vapors of 40% formaldehyde in airtight chambers, for three hours before using it in the water mains.

### **12.8 MAKING OF LEAD JOINTS**

The interior of socket and spigot ends is cleaned with a brush. The spigot end is inserted into the socket till it touches the bottom of the socket. Strands of twisted spun yarn and suitable thickness shall be driven tightly into the annular gap between the socket and spigot till the spun yarn touches the bottom of the socket, with a suitable yarning tool. Bits of spun yarn less than one circumference of spigot end shall not be used. Yarn packing should ensure annular gaps of uniform thickness all around. For pouring of lead to make the joints water tight clean hemp yarn shall be used (tarred hemp yarn shall be used only for sewerage works).

The approximate depth of yarn packing and lead caulking for different diameters of CI pipes are given in table I. Correct depth of yarn packing and thickness of each joint has to be checked by means of a wooden gauge by inserting it all around the annular gap. Wooden gauges with grooves to show the depth of yarn and lead caulking shall be prepared with reference to table I for each diameter of pipe.

**TABLE - I**

\*\*\*\*\*

Dia of pipe in mm	Total Appx.Qty depth of socket	Depth of yarn caulking	Depth of lead	Depth of of yarn/ caulking jointing kg./joint	Appx.Qty of lead in
80 mm	84 mm	39 mm	45 mm	0.10	1.80
100 mm	88 mm	43 mm	45 mm	0.18	2.20
125 mm	91 mm	46 mm	45 mm	0.20	2.60
150 mm	94 mm	49 mm	45 mm	0.20	3.40
200 mm	100 mm	55 mm	45 mm	0.30	5.00

\*\*\*\*\*

Note: +/- 20% variation in quantities of lead and spun yarn stated above can be permitted for a single joint. Average consumption/per joint should match to the above standards within a tolerance of 5%. For overall reduction in quantity of lead used for a given number of joints from the above standard, the corresponding cost of lead shall be deducted from the bill of the contractor. Quantity of lead used in the works shall be pre-weighed. Lead removed while caulking at the joint also shall be weighed and accounted for in order to arrive at the net quantity of lead consumed for jointing.

**12.9 HEATING AND POURING OF LEAD**

Lead shall be heated in a melting pot kept in easy reach of the joint to be poured so that the molten metal will not get chilled while being carried from the melting pot to the joint.

**Preparation of clay mould for pouring lead joints**

Moulds for pouring lead joints shall be prepared using well-kneaded clay, using a thick rope of size little larger than the annular groove. The rope is dampened with water and the watery clay shall be wound around the edge of the spigot end snugly fitting around the annular gap in-between the spigot end and socket face and the clay shall be clashed around to form the mould. The way for pouring lead in the mould shall be formed by carefully withdrawing the rope without dislodging the clay mould. A pouring lip shall be formed in the clay mould for pouring the lead.

When the molten lead is stirred it will show a rapid change of color. Before pouring, all scum shall be removed. Each joint shall be made with one continuous pour, filling the entire joint space with solid lead. After few minutes of cooling, the clay mould can be removed and the continuity of lead, examined. Spongy or imperfectly filled joints shall be removed and repaired.

**12.10 PARTIAL BACK-FILLING OF PIPE TRENCH BEFORE TESTING**



Before testing, the trench shall be partially back-filled except at the joints in accordance with provision of clause - 2.4.

### **12.11 HYDROSTATIC TESTING OF CI PIPES LAID AND JOINTED**

#### **TYPES OF TESTS**

After a new pipe has been laid and jointed it shall be subjected to the following tests pressure test at a pressure specified below Leakage test at a pressure to be specified by the authority for a duration of two hours.

#### **PROCEDURE FOR PRESSURE TEST– IS 3114 – 1985, IS 12288 - 1987**

Testing of pressure pipes - The field test pressure to be imposed should not be less than the greater than:

- i 1.5 times the maximum sustained operating pressure.
- ii 1.5 times the maximum pipeline static pressure.
- iii Sum of the maximum sustained operating pressures or the maximum pipeline static pressure and the maximum calculated surge pressure subject to a maximum, equal to the works test pressure for any pipes and fittings incorporated in the pipeline.
- iv The minimum test pressure in any case shall not be less than 10 kg/sq.cm.

If the pressure measurements are not made at the lowest point of the section, an allowance should be made for the static head between the lowest point and the point of measurement to ensure that the maximum pressure is not exceeded at the lowest point. If a drop in pressure occurs, the quantity of water added in order to re-establish the test pressure should be carefully measured. This should not exceed 0.1 litre per mm of pipe dia per km of pipeline per day for each 30 meters head of pressure applied. The field test pressure shall be conducted for the maximum pressure as stipulated in para 5.4 above for duration of four hours.

### **12.12 EXAMINATION UNDER PRESSURE**

All exposed pipes, fittings, valves, hydrants and joints should be carefully examined during the open trench test. When the joints are made with lead, all such joints showing visible leaks shall be rechecked until tight. When the joints are made with cement and show seepage of slight leakage, such joints shall be cut out and replaced as directed by the Engineer-in-Charge. Any cracked or defective pipes, fittings, valves or hydrants discovered in consequence of this pressure test shall be removed and replaced by sound materials and the test shall be repeated to the satisfaction of the Engineer-in-Charge.

The final pressure tests duration shall be at least one hour. Examination under pressure and passing of the test shall be done by the Engineer-in-Charge for all tests and only when Engineer-in-Charge is not available by any other Engineer specifically authorized by the Engineer-in-Charge

### **12.13 PROCEDURE FOR LEAKAGE TEST– IS 3114 - 1985**

A leakage test shall be conducted concurrently with the pressure test. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valve section thereof within 0,035 N/Sq.mm /0.35 Kgf/Sq.cm, of the specified leakage test pressure after the air in the pipeline has been expelled and the pipe has been filled with water (in case of test pressure is 10 Kgf/Sq.cm the leakage test pressure will be 3.5 Kgf/Sq.cm.)

No pipe installation shall be accepted until the leakage is less than the number of cu.cm/h as determined by the formula:

$$QL = \frac{ND \times (P)^{1/2}}{3.3}$$

Where QL = The allowable leakage in cu.cm/h,  
N = Number of joints in the length of the pipeline  
D = diameter in mm and  
P = The average test pressure during the leakage test in Kg/Sq.cm

#### 12.14 VARIATION FROM PERMISSIBLE LEAKAGE

The leakage or quantity of water supplied during testing shall not exceed 0.2 lts/mm diameter of pipe per kilometer of length per day.

#### 12.15 MODE OF MEASUREMENT OF PIPE AND FITTINGS WORK: -

The measurement of pipeline is done in running meters, (Rm.), and the specials and fittings are done in Nos. (Quantity of fittings in numbers only).The lead joints shall be measured separately. The mode of measurement shall be as per IS 1200 (Part 16).

The quoted rates should be as per above measurements.

The quoted rates shall also include

Cost of pipeline and fittings and jointing materials

Cost of laying , jointing and curing of pipes

Testing and making the defects good, if any.

## 13.0 CHLORINATED PVC PIPES (CPVC)

### 13.1 Scope

This specification covers requirements, test methods and methods of marking for chlorinated poly vinyl chloride plastic hot-and cold-water distribution system components made in one standard dimension ratio and intended for water service. These components comprise pipe and tubing, socket-type fittings, street fittings, plastic-to-metal transition fittings, solvent cements, and adhesives. Requirements and methods of test are included for materials, workmanship, dimensions and tolerances, hydrostatic sustained pressure strength, and thermo-cycling resistance. The components covered by this specification are intended for use in residential and commercial hot and cold potable water distribution systems.

### 13.2 Referenced Documents

ASTM Standards:

D 1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure

D1399 Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.

D1784 Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

D 1898 Practice for Sampling of Plastics

D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings<sup>2</sup>

D2444 Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)<sup>2</sup>

D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials<sup>2</sup>

F 402 Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings<sup>2</sup>

F 412 Terminology Relating to Plastic Piping Systems

F 493 Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings<sup>2</sup>

ANSI Standards:

ANSI B2.1-1968 Pipe Threads

ANSI Z17.1-1958 Preferred Numbers<sup>4</sup>

Federal Standard:

Fed. Std. No. 123 Marking for Shipments (Civil Agencies)<sup>5</sup>

Military Standard:  
MIL-STD-129 Marking for Shipment and Storage

NSF Standards:

Standard No. 14 for Plastic Piping Components and Related Materials<sup>6</sup>

Standard No. 61 for Drinking Water Systems Components—Health Effects

### Terminology

#### 13.3 Definitions:

General—The abbreviation for chlorinated poly vinyl chloride is CPVC. Plastic tubing denotes a particular diameter schedule of plastic pipe in which the outside diameter of the tubing is equal to the nominal size plus 1/3 in. (3.18 mm).

Relation between standard dimension ratio, stress, and internal pressure—the following expression is used to relate standard dimension ratio, stress, and internal pressure for pipe and tubing:

$$2S / P = R - 1$$

$$2S / P = (D_0/t) - 1$$

Where:

S = stress in circumferential or hoop direction, psi (MPa).

P = internal pressure, psi (MPa),

D<sub>0</sub> = average outside diameter, in. (mm),

T = minimum wall thickness, in. (mm), and

R = standard dimension ratio, SDR.

Standard dimension ratio (SDR)—a. selected series of numbers in which the average outside diameter to minimum wall thickness dimension ratios are constant for all sizes of pipe and tubing in each standard dimension ratio, and which are the ANSI Z17.1 Preferred Number Series 10 modified by +1. SDR fittings shall by definition be equivalent in minimum socket wall thickness to the minimum wall thickness of the corresponding SDR and size of pipe or tubing, and the minimum body wall thickness shall be 125% of that value.

Standard material designation code—the chlorinated poly vinyl chloride material designation code shall consist of the abbreviation CPVC followed by two digits indicating the ASTM type and grade in Arabic numerals. Where necessary, a third and fourth digit shall be added to indicate the hydrostatic design stress for water at 730F [230C] in units of 100 psi [0.69 MPa].

#### 13.4 Materials

Basic Materials Description—Chlorinated poly(vinyl chloride) plastics used to make pipe, tubing, and fittings meeting the requirements of this specification are categorized by two criteria; namely, basic short-term properties, and long-term hydrostatic strength. Sections 4.1.1 and 4.1.2 respectively define these categories.

Basic Short-Term Properties—This specification covers CPVC 41 pipe, tubing, and fittings made from plastic materials meeting the mechanical strength, heat resistance, flammability, and chemical resistance requirements for CPVC 23447-B in Specification D 1784.

Note 2

CPVC 23447-B was formerly designated as CPVC Type IV Grade 1, and is herein designated as CPVC 41. This is also used in marking pipe, tubing, or fittings.

Long-Term Hydrostatic Strength—This specification covers CPVC 41 pipe, tubing, and fittings which are further defined by hydrostatic design stress as CPVC 4120. Pipe and tubing are so defined on the basis of long-term hydrostatic strength tests and are made from compounds having an established 180°F [820C] hydrostatic design stress of 500 psi [3.45 MPa] or greater in accordance with Appendix XI and Test Method D 2837. Fittings are so defined by hydrostatic sustained pressure tests on fitting assemblies, required by this specification (see 6.2), based on the hydrostatic strength of the corresponding pipe or tubing.

Note 3

No hydrostatic design stress, as such, exists for fittings until such time as long-term hydrostatic strength test methods for fittings are developed.

Rework Material—Clean rework material generated from the manufacturer's own production may be used by the same manufacturer provided the pipe, tubing, or fittings meet all the requirements of this specification.

Classification

Pipe, Tubing, and Fittings—This specification classifies CPVC 4120 pipe, tubing, and fittings by a single standard dimension ratio which shall be SDR II, by a maximum continuous use temperature which shall be 1800F [820C] and by nominal pipe or tubing diameters from 3/8 in.[9.5 mm] through 2 in. [50 mm].

Plastic-to-Metal Transition Fittings—This specification classifies CPVC plastic-to-metal transition fittings intended for use up to and including 1800F [820C] as CPVC-I800F on the basis of resistance to failure by thermo-cycling.

Solvent Cements and Adhesives— This specification classifies solvent cements and adhesives meeting the requirements contained herein as CPVC Solvent Cement or CPVC Adhesive.

Requirements for Pipe, Tubing and Fittings

Dimensions and Tolerances:

13.5 General:

Wall Minimums—Table 1 and Table 2 show wall thickness minimums. Calculated SDR 11 tubing wall thicknesses that fall below 0.068 in. [1.73 mm] shall be arbitrarily increased to that value. Calculated SDR 11 fitting wall thicknesses that fall below 0.102 in. [2.59 mm] for the fitting socket bottom, or 0.128 in. [3.25 mm] for the fitting body, shall be arbitrarily increased to these values.

**Interference Fit**—The diameters and tolerances in Table 1 and Table 2 provide for socket-type joints having an interference fit based on the major diameter of pipe and tubing having a degree of out-of-roundness. This does not necessarily imply interference based on the minor diameter of the pipe or tubing.

**Out-of Roundness**—The maximum out-of-roundness requirements shown in Table 1 and Table 2 for pipe, tubing, and fittings apply to the average measured diameter.

**Pipe and Tubing:**

**Outside Diameter and Wall Thickness**—The outside diameters and wall thicknesses for pipe and tubing shall meet the requirements for dimension and tolerance given in Table 1 when measured in accordance with Test Method D2122.

**Wall Thickness Range**—The wall thickness range for pipe and tubing shall be within 12 % when measured in accordance with Test Method D 2122.

**Flattening**—There shall be no evidence of splitting, cracking, or breaking when the pipe is tested in accordance with 9.2

**Length**— Pipe and tubing supplied in straight lengths shall have a tolerance on any specified length of +1/2 -0 in. [+12.5, -0 mm].

**Socket-Type Fittings:**

**Dimensions**—Fitting sockets, inside diameters (waterways), wall thicknesses, laying lengths, and reducing bushing minimums shall meet the requirements for dimension and tolerance given in Table 2, Table 3, and Table 4 when measured in accordance with Test Method D2122. The spigot ends of street fittings shall meet the outside diameter and minimum wall requirements of Table 1.

**Alignment**—The maximum angular variation of any socket opening shall not exceed 1/20 off the true centerline axis.

### 13.6 Plastic-to-Metal Transition Fittings:

**Basic Dimensions**—Plastic parts of plastic to metal transition fittings shall meet the dimensional requirements of Table 1 and Table 2 where applicable with the following exceptions. Such parts shall be exempted from the requirements for inside diameter (waterway) and wall thickness tolerance.

**Thread Dimensions**—Transition fittings that rely on interference fit and sealant shall be threaded with American National Standard Taper Pipe Threads meeting the dimensional requirements of ANSI B2.1

**Thread Tolerance**— The manufacturing tolerance on CPVC threads, measured with a ring gage, shall be a maximum variation of 1½ turns large or small when measured in accordance with Test Method D 2122.

**Starting Threads**—The entering ends of external CPVC threads shall have a Blunt Start (see Fig. 1) produced by making the width of the thread at the start approximately 50 to 75% of

the full thread. The Blunt Start provides for easy entrance and protection of the thread, and shall be included in the measurement of thread length.

### 13.7 Hydrostatic Sustained Pressure:

General — Pipe, tubing, and fittings (tested as assemblies) shall meet the minimum hydrostatic sustained pressure requirements of both test conditions shown in Table 5 when tested in accordance with 9.2.

Pipe and Tubing Quality—Test condition B shall be termed the primary sustained pressure test for pipe and tubing and shall be used for quality control (see Appendix X3). Test condition A shall be termed the secondary sustained pressure test for pipe and tubing and shall be used for periodic performance qualification. Failure to pass either test is cause for rejection.

Fitting Quality—Test condition A shall be termed the primary sustained pressure test for fittings and shall be used for quality control (see Appendix X3). Test condition B shall be termed the secondary sustained pressure test for fittings and shall be used for periodic performance qualification. Failure to pass either test is cause for rejection.

Thermo cycling — Plastic-to-metal transition fittings (other than metal socket-type transitions for use with adhesives assembled according to the manufacturer's instructions, shall not separate or leak when thermo cycled 1000 times between the temperatures of 600F and 1800F [160C and 820C] in accordance with 9.3.8

### 13.8 Requirements for Solvent Cement and Adhesive Joints

#### CPVC Solvent Cements:

Note 6—CPVC solvent cements may exist which meet the requirements of the specification when used in accordance with the manufacturer's recommendations, without a primer or cleaner. It is recommended that those CPVC solvent cements which may be used without a primer or cleaner be clear or yellow in color. Otherwise, it is recommended that CPVC solvent cement requiring the use of 3 primer or cleaner be orange in color. Color identification is recommended to facilitate cement recognition to prevent the misuse of the cement and to minimize the unintentional use of other cements that may fail at elevated service temperatures.

General—CPVC solvent cements, for use in CPVC 41, plastic-to-plastic, socket-type joints shall meet the requirements set forth in Specification F 493.

Hydrostatic Burst Strength—2-in. [50-mm] CPVC solvent cement joints shall exceed the minimum hydrostatic burst strength requirements given in Table 6 after a maximum drying interval of 2 h when tested in accordance with 10.1.3, Failure to pass the burst requirement at either temperature is cause for rejection.

Hydrostatic Sustained Pressure Strength—½-in. [15-mm] CPVC solvent cement joints shall meet the requirements of 6.2 when tested in accordance with 9.3.

Safe Handling of Solvent Cement—Refer to Practice F402.



13.9 CPVC Adhesives:

General—CPVC adhesives (other than CPVC solvent cement), shall qualify for use in CPVC socket-type joints by a rigorous simulated use testing program as further defined in 7.2.2 and 7.2.3. CPVC adhesives shall be tested in the largest size joint and in the exact type of joint for which they are intended; that is, 2-in. [50-mm] plastic-to-metal or 2-in. [50-mm] plastic-to-plastic.

Hydrostatic Sustained Pressure Strength—Socket-type CPVC adhesive joints, made and cured according to the adhesive manufacturer's recommended procedure, shall not separate or leak when tested in accordance with 10.2 at the hydrostatic sustained pressure condition given in Table 7.

Thermo-cycling—Socket-type CPVC adhesive joints, made and cured according to the adhesive manufacturer's recommended procedure, shall not separate or leak when thermo-cycled 10000 times between the temperatures of 600F and 1800F [160C and 820C] in accordance with 10.2.

13.10 Workmanship, Finish, and Appearance

The pipe shall be homogeneous throughout and essentially uniform in color, opacity, density, and other properties. The inside and outside surfaces shall be semi-matte or glossy in appearance (depending on the type of plastic) and free of chalking, sticky or tacky material. The surfaces shall be free of excessive bloom, that is slight bloom is acceptable. The pipe walls shall be free of cracks, holes, blisters, voids, foreign inclusion, or other defects which are visible to the naked eye and which may affect the wall integrity. Holes deliberately placed in perforated pipe are acceptable. Bloom or chalking may develop in pipe exposed to direct rays of the sun (ultraviolet radiant energy) for extended periods and consequently these requirements do not apply to pipe after extended exposure to direct rays of the sun.

LIST OF RECOMMENDED MAKES

WATER SUPPLY & SANITARY INSTALLATION

1a	I. Galvanised Pipes	1	Tata	2	Jindal
1b	ii GI fittings	1	R Brand (ISI)	3	NVR
		2	Zoloto		
1c	CPVC pipes	1	Ashirvad (Flowguard)	2	Astral
1d	CPVC fittings	1	Ashirvad (Flowguard)	2	Astral
2	Stoneware pipes	1	TSL	2	Mysore Stoneware
3	Sanitary ware	1	Hindustan Sanitaryware	3	Cera
		2	Parryware	4	TOTO

4	Toilet Accessories	1 Jaquar 3 COTO	2 ESS ESS
5	CP fittings	1 Jaquar	2 ESS ESS
6	Gate valves/Non-return valves	1 Leader 2 Zoloto	3 NETA
7	Butterfly valves	1 Inter Valve 2 Slim Line	3 Fluid Line
8	Foot valves	1 Leader 2 Zoloto	3 NETA
9	Water closet seats & Cisterns	1 Commander	2 Parryplast
10	Mirrors	1 Saint gobian 3 Modifloat	2 ESS ESS
11	Pumps	1 Grundfos 2 Kirloskar	3 Beacon
12	Pipe supports	1 Hi-Tech pipe Support System	
13	Liquid level controllers	1 Sridhan International	2 Sri Vinayak
14	Kitchen sink	1 Frankee 2 Diamond	3 Nirali
15	PVC pipes & fittings	1 Prince 3 Kissan	2 Supreme
16	Pipe protection tape (PVC) underground	1 Tapex	2 Pipe coat
17	CI Centrifugal spun pipes	1 NECO	2 Bengal iron castings
18	Manhole frame & cover (Concrete)	1 Southern Concrete Industries	
19	Manhole PVC steps	1 Southern Concrete Industries	
20	CI manhole frame & Cover	1 Neco	2 Bengal iron castings

21	Urinal flushing sensor	1	ROBO	2	Fanda Hygiene Series
22	Soap dispenser	1	Kimberly Clark		
		2	Colgate Palmolive		
23	Hand Dryer	1	Nova - TECH		
24	Connection pipe to WC	1	Kohinoor (High Pressure)		
25	Water Heater	1	Racold	2	Venus
26	Hot water pipe Insulation	1	Vidoflex	2	Armaflex
27	PVC pressure pipes (schedule 40) & fittings	1	Prince		
		2	Supreme		
28	CI class LA pipes	1	Electro steel		
29	Copper Pipes	1	ABC	2	RAJCO
30	Submersible pumps	1	Grundfos	4	KSB
		3	Approved equivalent		
31	Pressure Gauge	1	H Guru	3	Gluck
		2	Bourdon	4	Ki international
32	Water meters	1	Dash - Mesh	3	Anand Asahi
		2	BHEL	4	Capstan
33	Pressure reducing Valve	1	Zoloto		
		2	Hawa		
34	Y Strainer	1	Kirloskar	3	Fluidline
		2	Leader	4	Neta
35	Motors	1	NGEF	3	Kirloskar
		2	Crompton Greaves	4	Siemens
36	Pressure relief valve	1	GG	3	Teleflo
		2	Leader		

**Annexure-E**  
**TECHNICAL SPECIFICATIONS**  
**FOR**  
**ELECTRICAL WORKS**

## **I - SECTION-1: INTERNAL ELECTRICAL WORKS**

### **IA. GENERAL SCOPE OF INTERNAL ELECTRICAL INSTALLATION WORK**

#### **IA 1.0 SCOPE**

This specification details the broad guidelines for supply, receive, store, erect, testing and commissioning of all the equipments required for the Electrical Installation. The contractor shall furnish all the materials, labour, tools and equipments for the electrical works, as shown in the accompanying drawings and in the bill of quantities and specifications hereinafter described and execute the works as directed by the EIC and completed to their entire satisfaction.

#### **IA 2.0 CONTRACTOR**

The Contractor shall be a licensed Class One or 'A' class Electrical Contractor, possessing a valid Electrical Contractor's license in the State, employing licensed supervisors and skilled workers having valid permits as per the Regulation of Indian Electricity Rules and Local Electrical Inspectors requirements. He should have executed electrical works of this magnitude earlier and shall have qualified engineers to produce execution drawings and to supervise the work at site.

#### **IA 3.0 MINIMUM REQUIREMENT OF TECHNICAL STAFF :-(AT SITE)**

One qualified, and competent experienced Engineer - Minimum 5-10 years experience in executing similar installations acceptable to the Owners/Architects.

Diploma Holders with atleast 5 years site experience.

Experienced Wireman. - Detail manpower loading chart to be furnished.

#### **IA 4.0 MINIMUM REQUIREMENT REQUIRED AT SITE:-**

Multimeter, 500/1000/2500/5000 V Megger, Earth	:	1 No. Each Duly calibrated
Resistance Meter	:	and certified by third party agency.
Tool kit containing, Double end spanners, Ring	:	1 Set for each Technician.
Spanners, Screw Drivers, Hammers, chisels etc.	:	

5 Mtr. Steel tapes	:	1 No. for each skilled Technician.
30/100 M steel tape for recording measurements	:	1 No.
Spirit level 450 mm long metal body	:	1 No. (Per Batch)
Hand Grinder	:	1 No. (Per Batch)
Hand drilling machine 1/2" HSS/Masonry	:	1 No. (Per Batch)
Pedestal drilling machine 5/8"	:	1 No.
Vices fixed to Tables	:	as required.
H.S.S / Masonry (mm) drill bits upto 16 mm	:	1 Set (per Building)
Hydraulic cable crimping device	:	Size / Quantity (As required)
Any other testing equipment as required	:	1 Set. Each.
First Aid approved kits	:	1 Set per Building & Additional quantities as required.

#### IA 5.0 DEFINITIONS

The following abbreviations used in the bill of quantities, specifications and drawings represent: -

IS	:	Indian Standard Specifications.
BS	:	British Standard.
HRC	:	High Rupturing Capacity.
GI	:	Galvanized Iron.
MS	:	Mild Steel.
CI	:	Cast Iron.
APLSTS	:	Aluminum Conductor, Paper Insulated Lead. : Sheathed, Double Steel Tape Armoured & Served.
XLPE	:	Cross Linked Polyethylene
PVC	:	Polyvinyl Chloride.
HT	:	High Tension.
LT	:	Low Tension.
AMP	:	Ampere.
KV	:	Kilo Volts.
PT	:	Potential Transformers.
CT	:	Current Transformers.
MOCB	:	Minimum Oil Circuit Breakers.
SF6	:	Sulfur Hexa Fluoride Breaker
VCB	:	Vaccum Circuit Breaker

ACB	: Air Circuit Breaker
MCCB	: Moulded Case Circuit Breakers.
ELCB	: Earth Leakage Circuit Breakers.
CFS	: Combination Fuse Switch.
MCC	: Motor Control Centre
PMCC	: Power and Motor Control Centre
MLP	: Main lighting Panel
MCB	: Miniature Circuit Breaker
FDB	: HRC Fuse Distribution Board.
LDB	: Lighting Distribution Board.
PDB	: Power Distribution Board.
KVA	: Kilo Volts Ampere.
KW	: Kilo Watts.
HP	: Horse Power.
SWG	: Standard Wire Gauge.

#### **IA 6.0 DETAILED SCOPE OF WORK**

Design, Supply of various equipment, unloading, receiving inspection, storing, transportation to work site, handling, assembling, cleaning, mechanical erection, chipping of foundations, installation, alignment, testing and commissioning and handing over in working condition of all items covered below but not limited to it.

- a) HT/LT Power and Control Cables.
- b) Metal Clad Switches, Sockets, conduiting, wiring.
- c) Lighting fixtures and accessories and lighting installation.
- d) Lighting and Power Distribution Boards, Feeder Pillars.
- e) 415 V MCC/PCC's, Automatic Capacitor Control Panels, Lighting Panels, Bus Ducts, etc.,
- f) Cable trays, earthing station/materials, lightning protection system.
- g) Transformers, Double Pole Structures.
- h) HT Switchgear and accessories
- i) Battery, Battery Charger, Annunciator, UPS, Invertor.
- j) Street Lighting, Security Lighting, Emergency Lighting & Indoor Lighting.
- k) Communication / Data Wiring.
- l) Any other items specified in Schedule of Quantities.

- 6.1 Minor civil works like drilling and punching holes and openings in concrete floors, slabs, chasing of brick walls, fabrication of supporting structures, drainage of water from cable trenches, cleaning and clearing of all debris due to electrical installation.
- 6.2 Excavation, scaffolding, back filling for direct burial of cables and earthing conductors as applicable.
- 6.3 Preparation of execution drawings and as built-in- drawings.
- 6.4 Coordination with other contractors with regard to installation of items in Electrical Contractors scope.

- 6.5 The extent of work services under the contract include all items shown on the drawings,indicated in companion with specifications,not withstanding the fact that such items have been omitted from the price schedule. All equipments and services which are required to complete the intent of the contract shall also be deemed to be within the scope of the contract.
- 6.6 After receiving/inspections of not only the materials supplied by him but also those supplied by the Owner,shall be reported to the Owner/Architect with his comments.

**IA 7.0 MATERIALS**

The materials listed under "APPROVED MAKE" only shall be used. A1.materials,equipments,fittings,etc.used in the installation shall conform to the latest relevant IS. In case of materials for which standard specifications do not exist,the material shall be got approved by the Architects before start of work.

**IA 8.0 CODE,REGULATIONS AND STANDARDS**

The installation shall conform in all respects to Indian Standard Code of Practice for Electrical Wiring Installation I.S.732-1982. It shall also be in conformity with the current Indian Electricity Rules Safety Codes and the Regulations and requirements of the Local Electrical Supply Authority. Wherever this specification calls for a higher standard of materials and/or workmanship then those required by any of the above regulatons,this specification shall take precedence over the said regulations and standards. In general,the materials,equipments and workmanship not covered by the above shall conform to the following Indian Standards(latest),unless otherwise called for.Nothing in the enclosed specification shall be construed to relieve the contractor of this responsibility.

Classification of degrees of protection provided by enclosures of electrical equipment	12063:1987 06
Electrotechnical vocabulary : Part 10 Power system protection (first revision of IS 1885)	1885 (Part 10):1993 03
Electrotechnical vocabulary : Part 11 Electrical measurements	1885 (Part 11):1966 09
Electrotechnical vocabulary : Part 16 Lighting, Section 2 General illumination, lighting fittings and lighting and traffic and signalling.	1885 (Part 16-Section 3):1967 10
Electrotechnical vocabulary : Part 17 Switchgear and controlgear (first revision)	1885 (Part 17):1979 08
Electrotechnical vocabulary : Part 28 Instrument transformers (first revision of IS 1885)	1885 (Part 28):1992 04
Electrotechnical Vocabulary : Part 32 Electric cables (first	



revision of IS 1885) Electrotechnical vocabulary : Part 55 Electric fans	1885 (Part 32): 1992 05 1885 (Part 55):1981 03
Graphical symbols for diagrams in the field of electrotechnology: Part 8 Measuring instruments, lamps and signalling devices.	12032(Part 8):1987 07
Air circulator type electric fans and regulators (with amendment No.5)	2997:1964 06
Industrial cooling fans (man coolers) (first revision) (with amendment No.1)	6272:1987 05
AC supplied electronic ballasts for tubular florescent lamps :Part I, General and safety requirements.	13021(Part 2):1991 05
Ballasts for high pressure mercury vapour lamps (first revision)	6616:1982 08
Bayonet lamp holders (third revision)(with amendment no.2)	1258:1987 10
High pressure mercury vapour lamps:Part 3, Dimensions of lamp caps (superseding IS:2183 and IS:7023)	9900(Part 3):1981 03
Code of practice for earthing	3043:1987
Code of practice for electrical wiring installations(third revision)	732:1989
Code of practice for the installation of electric bells and call system	8884:1978 03
Code of practice for the protection of buildings and allied structures against lightning (second revision)	2309:1989 15
Danger notice plates (first revision)	2551:1982 05
Guide for electrical layout in residential buildings (with amendment No.1)	4648:1968 04
Guide for improvement of power factor in consumer installation Part I, Low and medium supply voltages	7752 (Part I):1982 06
Guide for safety procedures and practices in electrical work: Part 2, Life saving techniques (first revision)	5216(Part 2):1982 06
Special publication - National Electrical Code	30:1984
Special publication Chart on treatment for electric shock	31:1986

Warning symbol for dangerous voltages	8923:1978 01
Accessories for rigid steel conduits for electrical wiring (first revision)	3837:1976 04
Adaptors for flexible steel conduits	4649:1968 03
Appliance-connectors and appliance-inlets (non-reversible three-pin type): Part 1, Appliance connectors (with amendment No.6)	3010(Part 1):1965 05
Boxes for enclosure of the electrical accessories:Part 1, Steel and cast iron box (with amendment No.2)	5133(Part 1):1969 03
Boxes for the enclosure of electrical accessories:Part 2, Boxes made of insulating material	5133(Part 2):1969 03
Ceiling roses (second revision) (with amendment No.4)	317:1979 05
Conduits for electrical installations:Part I,General requirements	9537(Part 1):1980 05
Conduits for electrical installations:Part 3, Rigid plain conduits of insulating materials (superseding IS:2509)	9537(Part 3):1983 04
Conduits for electrical installation:Part 2, Rigid steel conduits (superseding IS:1653)(with amendment No.2)	9537(Part 2):1981 04
Fittings for rigid non-metallic conduits (second revision)	3419:1988 07
Fittings for rigid steel conduits for electrical wiring (first revision)	2667:1988 05
Interlocking switch socket outlet (with amendment No.2)	4160:1967 06
Plugs and socket outlets of rated voltage upto and including 250 volts and rated current upto and including 16 Amps (second revision) (with Amendment No.3)	1293:1988 09
AC electricity meters:Part 2, Single-phase whole-current watt hour meters, Class II (first revision)(with amendment No.4)	722(Part 2):1977 02
AC electricity meters:Part 3, Three-phase whole current and transformer operated and single-phase transformer operated watt-hour meters, class 2(Second revision)(with amendment No.2)	722(Part 3):1977 03
AC electricity meters:Part 5, Volt-ampere hour meters for restricted power factor range, class 3.5 (first revision) (with	

amendment No.2)

722(Part 5):1980 05

Guide for testing, calibration and maintenance of AC electricity meters:Part 1, Single phase whole current wat hour meters, Class 2.o (first revision)

9792(Part 1):1987 06

## **IA 10.0 SUBMISSIONS**

**10.1 DRAWINGS** : The contractor shall prepare and submit to Owner for their approval electrical power layout drawing, lighting layout drawing, lightning protection drawing, earth layout drawing, Fire alarm & protection drawing as per TAC norms, IT/LAN networking drawings to interconnect all work stations ,cubicles & rooms. execution drawings and shop drawings of all switch boards, distribution boards, cable trays, conduit layouts and any fabricated items within 30 days of signing the contract.

### **10.1.1 EXECUTION DRAWINGS:**

The contractor shall submit six sets of blue prints to the Architects within 30 days of the Letter of Intent from the Owner. These drawings shall contain the following :-

- a) Routing and runs of conduits,diameter of conduits,number of wires run in each conduit,size of wires for point wiring,circuit mains,sub-mains,etc.
- b) The layout drawing shall include location of lighting fixtures,switch boards,distribution boards,socket outlets,conduit arrangement,number of wires and size,junction boxes,pull boxes,etc. The drawing shall also include a table furnishing the make and quantity of submains circuits, point wiring,lighting fixtures,socket outlets,etc.
- c) Cable routing,cable size,number of cables,cable marker locations.
- d) Cable schedule with details such as cable numbers,route lenghts,from and to,etc.
- e) Earthing scheme/size layout,location of earth stations with calculations.
- f) Complete layout drawings.
- g) Complete schematic diagram of the installation.
- h) Any other details as required.
- i) Revision of drawings as and when required and obtain approval from Architects.

All the drawings shall be of A-1 standard size. Lettering shall be stencilled. Original tracings shall be submitted. The drawings shall carry the Contractor's title block giving his company's name,address and shall be signed by the Authorised representative.

**10.1.2 AS BUILT DRAWINGS/OPERATION AND MAINTENANCE MANUALS / INSPECTION AND TEST**

**REPORT:** The contractor shall submit one complete set of original drawings and three copies of blue prints of the latest revised execution drawings with updated details as per site conditions blue. Operation and maintenance manual with ITP properly documented shall be submitted in two sets for all equipments supplied and erected by the contractor.

**NOTE :** Failing to comply with the above,will result in withholding the release of the retention money,and any other payments due to the contractor,and issue of virtual completion certificate.

**IA 11.0 SITE ENGINEER**

The Contractor shall employ a competent, licenced qualified full time electrical Engineer to direct the work of electrical installations in accordance with the drawings and specifications. The Engineer shall be available at all times on the site to receive instructions from the Architect/Owner in the day-to-day activities throughout the duration of the contract. The Engineer shall correlate the progress of the work in conjunction with all the relevant requirements of the supply authority. The skilled workers employed for the work should have requisite qualifications and should possess competency certificate from the Electrical Inspectorate of Local Administration.

**IA 12.0 APPLICATION FOR POWER SUPPLY, FEES, PERMITS, TESTS AND INSPECTION/APPROVAL BY LOCAL AUTHORITIES :**

The contractor shall be responsible for filing and follow up of application for getting the drawings/scheme approved by the Electrical Inspector and finally the whole installation shall be got approved by the Electrical Inspector. The contractor shall pay all fees and the same shall be reimbursed by the Owners at actuals on submission of receipts, On completion of this work,the contractor shall obtain and deliver to the Architects/Owners certificate of final inspection and approval by the Local Electrical supply authority. The Architect/Onwers shall have full powers to require the materials or works to be tested by an independent agency at the Electrical Contractors expenses in order to establish their soundness and adequacy.

**IA 13.0 GENERAL SCOPE**

- 13.1 The Contractor shall furnish all tools, welding equipment testing equipment,test connections and kits,etc.required for complete installation,testing and commissioning of the items included in the contract work.
- 13.2 The rates quoted by Contractor shall include all necessary MS channels, angles, etc.required for erection of panels, distribution boards,etc.in floor / walls/ cable trenches as required.
- 13.3 The contractor shall co-operate through the Architect/Owner/Engineer with other contractors at site,in all matters of common interest,so as not to obstruct operation of others and to ensure the safety of all personnel and works covered under this specification.

- 13.4 The work shall be carried out strictly as per the instructions and execution drawings. In case of any doubt/misunderstanding as to correct interpretation of the drawings or instructions, necessary clarifications shall be obtained from the Owner/Architect. This contractor shall be held responsible for any damage to the equipment consequent to not following the Manufacturer's instructions correctly. All necessary drawings,Manufacturer's equipment manuals shall be furnished to the owners and a copy to Architects.
- 13.5 All thefts of equipments/component parts,after take over by the Contractor,till the installation is handed over to the Owner,shall be make good by the Contractor.
- 13.6 The Contractor shall have a separate cleaning gang to clean all equipment under erection and as well as the work area at regular intervals to the satisfaction of the Owner/Architects. In case the cleaning is not to the Owner's satisfaction he will have the right to carryout the cleaning operations and any expenditure incurred by the Owner in this regard will be to the Contractor's account.
- 13.7 In order to avoid hazards to personnel moving around the equipment such as switchgear,etc.which is kept charged after installaion before commissioning,such equipment shall be suitably cordoned off to prevent anyone accidentally going near it.
- 13.8 The Contractor shall carry out touch-up painting on any equipment indicated by the Onwers/Architects,if the finish paint on the equipment is soiled or marred during installation handling.
- 13.9 Equipment shall be installed in a professional manner so that it is novel,plumb,square and properly aligned and oriented. No equipment shall be permanently bolted down to foundation or structure until the alignment has been,checked and found acceptable by the Owner/Architects.

#### **IA 14.0 TOOLS,TACKLES AND OTHER MATERIALS**

- 14.1 The Contractor shall also furnish all necessary consumables like anchor bolts and nuts, rawl plugs, hacksaw blades, taps, dies, drills, files, wire brushes, necessary pipe scaffolding, ladders, wooden and consumable material like oxygen, acetylene, greases, cleaning fluids, fasteners, gaskets, temporary supports, cotton waste and all other miscellaneous supplies of every kind required for carrying out the work under the contract.
- 14.2 The Contractor shall not dispose off transport or withdraw any tools, tackles, equipment and material provided by him for the contract without taking prior written approval from Owner/Architect. Owner/Architect at all times shall have right to refuse permission for disposal, transport or withdrawal of tools, tackles, equipment and material if in his opinion, the same will adversely affect the efficient and expeditious completion of the project.

#### **IA 15.0 TESTING AND COMMISSIONING**

- 15.1 All checks and tests as per the Manufacturer's drawings /manuals relevant code of installation and commissioning for various types of equipments shall be carried out by the contractor as part of installation work.

- 15.2 High voltage testing by voltage boosters, relay calibration by secondary injection and meter calibration have to be carried out at site by authorised agencies before commissioning.
- 15.3 The Owner may ask for such additional tests on site as in his opinion are necessary to determine that the works comply with the specifications, Manufacturer's guarantee/instructions or the applicable code of installation. The contractor shall carry out such additional tests also.
- 15.4 The Owner's authorised representative shall be present during every test as called for by the Owner. The Contractor shall record all test values and furnish the required copies of the test data to the Owner. Electrical circuits and equipments shall be energised or used at nominal operating voltage only after such reports have been accepted as satisfactory by the Owner.

**IA 16.0 HANDING OVER AND TAKING OVER OF WORKS/EQUIPMENT/SYSTEMS**

The Contractor shall hand over and the Owner shall take over the works/equipments/systems covered under this contract only after they have been completely installed, tested and commissioned in all respects by the Contractor to the entire satisfaction of the Owner/Architect and after the said operation. And all relevant test forms/certificates operation and maintenance manual's, as built drawings, etc. Incomplete/partly commissioned works/equipments/system will not be taken over by the Owner. In this regard, the decision of the Owner/Architect will be final and binding on the Contractor.

**IA 17.0 SAMPLES**

The Contractor shall submit two sets of samples of accessories and apparatus proposed to used in the installation to the Project Manager/Architects along with execution for approval. Drawings of samples as required, shall be submitted by the contractor and this specification shall not be departed from without the written instructions from the Project Manager/Architects. The verbal approval given by the Architects to any drawings or samples submitted by the contractor shall in no way exonerate the contractor from their liability to carry out the work in accordance with the forms of contract.

**I B. BLANK****IC1. TECHNICAL SPECIFICATION FOR 415 VOLTS SWITCH BOARDS (INDOOR/OUTDOOR)****IC 1. SCOPE**

This specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works, properly packed for transportation, supply and delivery testing and commissioning complete in all respects with all components, fittings and accessories for efficient and trouble-free operation as specified hereinafter for the proposed project.

**IC 2. GENERAL INFORMATION**

The equipment's shall be designed, manufactured and equipped with accessories in accordance with this specification and the applicable codes standards indicated below. Materials and components not specifically stated in this specification but which are necessary for satisfactory and trouble free operation and maintenance of the equipment shall be supplied.

2.1 The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance and service life as specified herein.

2.2 Switchboards shall be suitable for an ambient temperature of 45 C.

**IC 3. CODES AND STANDARDS**

3.1 The equipment covered by this specification shall unless otherwise stated be designed, constructed and tested in accordance with the requirements of the Indian Electricity Act and Rules and latest revision of the following standards.

IS 375	:	Arrangement of bus bars, main connection and auxiliary wiring.
IS 335	:	Insulating coils.
IS 722	:	AC electricity meters.
IS 1248	:	Direct acting electrical indicating instruments.
IS 13947	:	Motor starters AC, for voltage not exceeding 1000 V
(Part-4,Sec 1)	:	Direct-on-line AC starters.
IS 2099	:	Bushings.

IS 13947	:	Degree of protection provided by enclosures for low voltage (Part :- I) switchgear and control gear
IS 2419	:	Dimensions of panel mounted electrical indicating and recording instruments.
IS 13947 (Part 2)	:	Circuit Breakers.
IS 2607	:	Air-break isolators for voltage not exceeding 1000 Volts.
IS 2705	:	Current Transformers.
IS 4201	:	Application guide for CT's
IS 13947 (part 4,sec 1)	:	Contractors for voltages not exceeding 1000 V AC or 1200 V DC.
IS 3072	:	Installation and maintenance of switchgear
IS 3231	:	Electrical relays for power system protection.
IS 13947 (Part 3)	:	Air-break switches, air-break disconnectors and fuse combination units for voltages not exceeding 1000 V AC or 1200 V DC.
IS 3842	:	Application guide for electrical relays for AC System.
IS 4047	:	Heavy duty air break switches and composite units of air break switches and fuses for voltages not exceeding 1000 V.
IS 4146 IS 3156	:	Voltage Transformers.
IS 13947	:	General requirements for switchgear and control gear for (Part 1) voltages not exceeding 1000 Volts.
IS 4483	:	Preferred panel cut-out dimensions for electrical relays.
IS 5124	:	Induction motor starters, AC (voltage not exceeding 1000 V) installation and maintenance of code of practice.
IS 5987	:	Selection of switches (voltage not exceeding 1000 V)



- IS 6875 : Control switches for voltages upto and including 1000V AC & 1200 DC.
- IS 8588 : Code of practice for thermostatic bimetals Part-I general requirements and method of tests.
- IS 8623 : Factory built assemblies of switchgear and control gear for voltages upto and including 1000 V AC and 1200 V DC.
- IS 8828 : Miniature air-break circuit breakers for voltages not exceeding 1000 Volts

#### **IC 4. SCOPE OF SUPPLY UNDER THIS SPECIFICATION/CONTRACT**

As required to meet up completion of service building scope of work.

#### **IC 5. EQUIPMENT/SCOPE EXCLUDED FROM THIS SPECIFICATION/CONTRACT**

- 5.1 All concrete foundations.

#### **IC 6. DESIGN REQUIREMENT**

- 6.1 The switchboards shall be designed for 415 V, 3 phase, 4 wire, 50 c/s supply.
- 6.2 Switchboards shall be suitable for direct-on-line /Star Delta /Soft Starter / VFD starting of all motors as detailed in the schematic drawings.
- 6.3 Switchboards shall be rated for minimum fault level as mentioned in data sheets / Drawings.
- 6.4 Control power supply of the switchboards shall be 240 V, 1 Phase, 50 Hz AC supply tapped from the respective module itself.
- 6.5 The switchboards manufacturers shall apply all derating factors necessary to all components of the switchboards to comply with the conditions detailed in this specification.
- 6.6 The ratings of motors, control-gears, fuse switches, etc. furnished in the drawings are for tender purposes only. Any changes in the above will be intimated at the time of placement of purchase order or before fabrication of panels.
- 6.7 The MCC shall be modular, nondrawout type with the specified type of starters.
- 6.8 The fault level of all LT panels shall be for 1 sec. And rating shall be as specified in the schematics. The tenderer must have got the bus bar design short circuit tested at CPRI for the lowest bus bar rating under offer. The test certificate to this effect are to be submitted with the tender , otherwise the offer shall not be considered

#### **IC 7. CONSTRUCTIONAL FEATURES**

- 7.1** The switchboard shall be :
- 7.1.1 Of the totally metal enclosed, indoor, floor mounted, free standing cubicle type with draw out ACB and fixed type CB/switch units, with compartmentalized design.
  - 7.1.2 Made up of the requisite vertical sections, which when coupled together shall form continuous dead front switch boards.
  - 7.1.3 Provide dust and damp protection, the degree of protection being no less than IP 54 to IS 2147.
  - 7.1.4 Readily extensible on both sides by the addition of vertical sections after removal of the end covers.
  - 7.1.5 Provided with access to the feeders, bus bars, cable termination, cable alley etc. from front only.
  - 7.1.6 Minimum module height of 300mm
  - 7.1.7 Maximum no. of modules in one vertical panel not to exceed six.
  - 7.1.8 For MCC feeders, the rating of switch and contactor for each rating of motor shall be indicated.
- 7.2** Each vertical section shall comprise :
- 7.2.1 A front framed structure rolled/folded sheet steel channel section, of minimum 3 mm thickness, rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, fuse switch units, main horizontal busbars, vertical risers and other front mounted accessories.
  - 7.2.2 The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 3 mm thickness and atleast 75 mm height. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.
  - 7.2.3 Each compartment shall be provided with a hinged door interlocked with switch/breaker housed inside the compartment so that door can not be opened unless the switch/breaker is in 'OFF' position.
  - 7.2.4 A cable chamber housing of minimum width 300 mm shall be provided for the cable end connections, and power/control cable terminations. The design shall ensure generous availability of space of ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts in and adjacent section.

- 7.2.5 A cover plate at the top of the vertical section, provided with a ventilation hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.
- 7.2.6 Front and rear doors shall be fitted with dust tight neoprene gaskets with easy operating type fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust. The doors shall have concealed hinges. Removable screwed covers shall be provided on the rear of the cubicles.
- 7.2.7 A set of horizontal main bus bars shall be provided at the top or bottom as required. The vertical bus bars shall be housed in separate fully enclosed chamber of min. width 350 mm and accessible from front and shall be tapped off from main horizontal bus bars.
- 7.2.8 All incoming/outgoing terminals of the individual feeders shall be provided with insulated shrouds to avoid accidental contact with live parts. Also Terminal Blocks for suitable sized wires/cables shall be provided for all panels facilitating the easy termination of cables/wires to the MCBs, MCCBs, ACBs, SFUs, etc. These terminal blocks shall be prewired internally from the respective switchgear component.
- 7.2.9 The height of the panel should not be more than 2200 mm. The working height shall be limited to a maximum height of 1800 mm. The total depth of the panel should be adequate to cater for proper cabling space. Panels arranged side by side or in same room shall have same height and depth.
- 7.3 Covers and partitions shall be of minimum 16 Gauge sheet steel, whereas doors shall be of min. 14-gauge sheet steel. All sheet steel work forming the exterior of switchboards shall be smoothly finished, leveled and free from flaws. The corners should be rounded.
- 7.4 All switches, push buttons etc. shall be operatable from the front and shall be flush/semi-flush mounted.
- 7.5 The apparatus and circuits shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary of degree of safety.
- 7.6 Apparatus forming part of the switchboards shall have the minimum clearances as per relevant IS. Clearances shall be maintained during normal service conditions. Creepage distances shall comply to those specified in relevant standards.
- 7.7 All insulating material shall be of DMC/FRP/SMC to withstand the effects of high humidity, high temperature, tropical ambient service conditions etc.
- 7.8 Each module of the draw out type switch boards shall have draw out type contacts for power termination both incoming and outgoing sides. The control leads shall also be wired through withdrawable contacts.
- 7.9 Foundation bolts and nuts for each panel shall be supplied along with the respective switchboard.

- 7.10 The lifting eyes for each shipping section and danger notice plates shall be provided for each switchboards.
- 7.11 Functional units such as circuit breakers and fuse switches
- 7.12 Metallic/insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with :
- 7.12.9 Main bus bars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.
- 7.12.10 Cable termination's of one functional unit, when working of those of adjacent unit/units.
- 7.13 All covers providing access to live power equipment/circuits shall be provided with tool operated fasteners to prevent unauthorized access.
- 7.14 Provision shall be made for permanently earthing the frames and other metal parts of the switchgear by the independent connections.

#### **IC 8. METAL TREATMENT AND FINISH**

- 8.1 All steel work used in the construction of the switchboards should have undergone a rigorous metal treatment process.

All surface to be painted including interior and exterior of panels, and other metal parts shall be chemically treated to remove all rust, scale, grease and other adhering foreign matters. All parts shall be coated with two coats of highly corrosion resistant primer followed by two coats of synthetic enamel paint of approved colour of approved manufacturer. The finish shall be glossy or matt as required.

The complete treatment, painting, and drying with compressed air operations shall be done in dry and dust free atmosphere.

Should finished paint chip off or crinkle during transit/handling/installation, the contractor shall arrange for repainting the equipment at site at his own cost.

#### **IC 9. BUSBARS**

- 9.1 The busbars shall be air insulated and made of high conductivity, high strength aluminium alloy complying with the requirements of grade E91E of IS 5082 and suitable for 415 Volts, 4 wire 50 Hz system.
- 9.2 The busbars and connections shall be suitably supported/braced with non-hygroscopic DMC/FRP/SMC supports to provide a fault withstand capacity as specified.
- 9.3 High tensile bolts and spring washers shall be provided at all busbar joints.
- 9.4 The busbars shall be liberally sized and shall have uniform cross section throughout, and shall be capable of carrying the rated current at 415 V continuously. The busbars shall be designed

- to withstand a temperature rise of 45 C above the ambient. A current density of 0.8 Amps/Sqmm shall not be exceeded for Aluminium busbars whereas 1.3Amps/Sq.mm shall not be exceeded for Copper busbars.
- 9.5 All bus connections, joints and taps shall be short and as straight as possible, and applied with contact grease in the mating surface.
- 9.6 The main horizontal busbars shall be run through the entire length of the panel and shall be accessible for maintenance from the front as well as rear. Busbar chamber shall have separately screwed covers. All busbars, links etc. shall be provided with insulating cover to prevent accidental contacts. The natural busbars shall have a continuous rating of atleast 50% of the phase busbars.
- 9.7 Busbars shall be encased in colour coded heat shrunk PVC sleeves (snug fit type). An aluminium earth bus of size not less than 50 X 6 mm shall run through the length of switch boards at top or bottom as required.

#### **IC 10. CIRCUIT BREAKERS**

- 10.1 Circuit breakers shall be triple pole, air break, horizontal drawout type.
- 10.2 The breakers shall comply with the requirements of IS 13947 (Parts II & II/Sec. I) - 1977- Short Circuit Performance Category P-2, and shall have :
- 10.2.1 A short circuit breaking capacity of not less than 16 KA RMS at 415 Volts 50 Hz AC.
- 10.2.2 Mechanical and electrical endurance for 2000 operating cycles out of which 100 cycles should be for electrical endurance.
- 10.2.3 Electrical overload performance at 6 times the rated current, 110% of the rated voltage as recovery voltage and 0.5 power factor.
- 10.2.4 Dielectric test of 2.5 KV applied for one minute on main circuits.  
Test evidence from a recognized independent Laboratory / Institution shall be furnished for compliance of the breakers with the above requirements.
- 10.3 The circuit breakers shall be fitted with detachable arc chutes on each pole designed to permit rapid dispersion, cooling and extinction of the arc. Interface barriers shall be provided to prevent flashover between phases.
- 10.4 Arcing contacts shall be of hard wearing material of copper tungsten or silver tungsten and shall be readily replaceable. Main contacts shall be of pure silver of high-pressure butt type of generous cross section.
- 10.5 The operating mechanism shall be of robust design, with a minimum number of linkages to ensure maximum reliability. Manually operated circuit breakers shall be provided with spring operated closing mechanism which are independent of speed of manual operation. Electrically operated breakers shall have a motor wound spring

charged closing mechanism. Breaker operation shall be independent of the motor, which shall be used solely for charging the closing spring.

- 10.6 The operating mechanism shall be such that the breaker is at all times free to open immediately the trip coil is energized.
- 10.7 Mechanical operation indicators shall be provided to show open and closed position of the breaker. Electrically operated breakers shall be additionally provided with mechanical indications to show charged and discharged conditions of the charging spring.
- 10.8 Means shall be provided for slow closing and opening of the breaker for maintenance purposes, and for manual charging and closing of electrically operated breakers during emergencies.
- 10.9 Provision shall be available for fitting a minimum of five trip devices- three over current, a shunt trip and an under voltage release or two over current, and earthfault release, a shunt trip and one under voltage release. The breakers shall be of the shunt or series trip type as specified. For static trip device either a shunt trip or an under voltage coil shall be provided.
- 10.10 Circuit breakers shall be individually housed in sheet metal cassettes provided with hinged doors. The breaker along with its operating mechanism shall be mounted on a robust carriage moving on guide rollers within the cassette. Isolating contacts for both power and control circuits shall be of robust design and fully self-aligning. The assembly shall be designed to allow smooth and easy movement of the breaker within its cassette.
- 10.11 The breaker shall have three distinct positions within the cassette as follows :
  - a) 'Service' position : with main and auxiliary contacts connected.
  - b) 'Test' position : with power contacts fully disconnected and control circuit contacts connected.
  - c) 'Isolated' position : with both power and control circuit contacts fully disconnected.

It shall be possible to achieve any of the above positions with the cassette door closed. Mechanical position indicators shall be provided for the three positions of the breaker.

- 10.12 The moving portion of the circuit breaker shall be so interlocked that :
  - It shall not be possible to isolate it from the connected position, or to plug it in from the isolated position with the breaker closed.
  - The circuit breaker can be closed only when it is in one of the three positions or when it is fully out of the cassette.
  - It shall not be possible to open the hinged door of the cassette unless the breaker is drawn to the isolated position.

- Inadvertent withdrawal of the circuit breaker too far beyond its supports is prevented by suitable stops.
- 10.13 Moving portions of breakers of the same ratings shall be interchangeable.
- 10.14 Provision shall be available for the padlocking of the circuit access flaps in any of the three positions.
- 10.15 Automatically operated safety shutters shall be provided to screen the fixed isolating contacts when the breaker is drawn out from the cassette.
- 10.16 The moving portion of the circuit breaker shall be provided with a heavy duty self-aligning earth contact, which shall make before and break after the main isolating contacts during insertion into and withdrawal from the service position of the breaker. Even in the isolated position positive earthing contact should exist.
- 10.17 Auxiliary switches directly operated by the breaker operating mechanism and having 4 NO and 4 NC contacts, shall be provided on each breaker. The auxiliary switch contacts shall have a minimum rated thermal current of 10 Amps.

#### **IC 11. INDICATING LAMPS (LED TYPE)**

- 11.1 Filament type indicating lamps shall be provided wherever called for in the control schematic diagrams. The lamps assembly shall be complete with cluster of LED's, holders and lenses.

#### **IC 12. FUSES**

- 12.1 All control and power fuses, if any, shall be link type HRC fuses and they shall be provided with visible indication to show that they have operated.

#### **13. CURRENT TRANSFORMERS**

- 13.1 Current transformers shall comply with the requirements of IS 2705. They shall have ratios, outputs and accuracy's as specified/required.
- 13.2 Current transformers wherever required and called for in the single line diagram and/or required shall be furnished.
- 13.3 The CTs shall be bar primary, in epoxy encapsulated type, rated for 415 V. The CTs shall be designed to withstand the thermal and mechanical stresses resulting from the maximum short circuit current.

- 13.4 The vendor shall ensure that the VA output of the CTs are adequate for the relays, meters and loads connecting them.
- 13.5 The CTs shall be provided with Class A/Class B insulation and proper polarity markings in a suitable manner.

**IC 14. INDICATING/INTEGRATING METERS**

- 14.1 All indicating instruments shall be of flush mounting industrial pattern, conforming to the relevant standard.
- 14.2 The instruments shall have non-reflecting bezels, clearly divided and indelibly marked scales and shall be provided witherto adjusting devices in the front.
- 14.3 Integrating instruments shall be of flush mounting switchboard pattern, conforming to the relevant standards.
- 14.4 Meters shall be provided with circular 90 scale with square casing of specified size.
- 14.5 MT instruments shall have + or - 1% accuracy on full scale. Each meter shall be magnetically screened.

**IC 15. CABLE TERMINATIONS**

- 15.1 Cable entries and terminals shall be provided in the switchboard to suit the number, type and size of aluminium conductor power cables and copper conductor control cable specified in the detailed specifications.
- 15.2 Switch board shall be designed either for top or bottom or combined entries and outgoing which will be confirmed by Architects at the time of drawing approval. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Removable undrilled plates shall be furnished for fitting the cable glands.
- 15.3 Sufficient space shall be provided to avoid sharp bending and for easy connection. A minimum space of 200 mm from the gland plate to the nearest terminal block shall be provided.
- 15.4 Multiway terminal blocks complete with screws, nuts, washers and marking strips shall be furnished for terminating the internal wiring and outgoing cables.



- 15.5 Power and control terminals shall be washer head screw type or stud type complete with crimping type connectors. Screw type terminals with screws directly impinging on conductor are not acceptable.
- 15.6 Each control terminal shall be capable for connection of 2 Nos. 2.5 mm standard copper wires at each ends.
- 15.7 Not more than two wires shall be connected to any terminal. If necessary a number of terminals shall be jumpered together to provide wiring points.
- 15.8 Atleast 20% spare terminals shall be provided in each module.
- 15.9 Terminal blocks for current transformer secondary lead wires shall be provided with shorting and earthing facility.
- 15.10 Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.
- 15.11 Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

**IC 16. CONTROL WIRING**

- 16.1 The wiring shall be complete in all respects so as to ensure proper functioning of control, protection and interlocking scheme.
- 16.2 All wiring shall be completed upto terminal blocks on the side of each unit-module.
- 16.3 All control wiring shall be carried out with 1100/660 V grade single core PVC cable having stranded copper conductors of minimum 2.5 Sqmm.
- 16.4 Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wires shall not be spliced or tapped between terminal point.
- 16.5 Wires shall be identified by numbered ferrules at each end. The ferrules shall be of the ring and of non- deteriorating material. They shall be firmly located on each wire so as to prevent free movement, and shall be interlocking type.
- 16.6 All control circuit fuses shall be mounted in front of the panel and shall be easily accessible.
- 16.7 All spare contacts of relays and switches shall be wired upto the terminal blocks.
- 16.8 Each of the DC circuit shall be provided with two fuses one in the positive and the other in the negative for 2 wire DC underground system of specified voltage.

**IC 17. GROUND BUS**

- 17.1 An aluminium ground bus rated to carry maximum fault current shall be furnished along the entire length of each switchboard. Each stationary unit shall be connected directly to this ground bus by two separate and distinct connections in accordance with Indian Electricity Rules.
- 17.2 Grounding terminals on the ground bus shall be provided. Connectors shall be provided at either end of switch board for connection to station ground mat.

**IC 18. TERMINAL BLOCKS**

- 18.1 Terminal blocks shall be of 660 Volts grade of stud type. Insulating barriers shall be provided between adjacent terminals.
- 18.2 Suitable provision shall be made to terminate control/power connections in the respective module.
- 18.3 Terminal blocks shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions. The wire termination's to the blocks shall be of screw type suitable for crimp type socket.

**IC 19. NAME PLATE**

- 19.1.1 The panel as well as feeders compartments shall be provided with name plate of anodized aluminium, with white engraving on black background. They shall be properly secured with self tapping screws at the top of the cubicles. The panel/feeder descriptions shall be as indicated in the drawings/employers. The size of the nameplates shall be proportionate to the respective equipment's.
- 19.2 Also individual panel number and danger plate shall be furnished at back of panel.

**IC 20. ACCESSORIES**

- 20.1 The following accessories shall be furnished along with each switchboard.
- 20.2 One (1) no. fuse pulling handle for each switchboard.
- 20.3 One (1) no. winding handle for withdrawing breaker from the cubicle.
- 20.4 Other accessories as deemed necessary for trouble free and efficient operation of the equipment offered.

**IC 21. DRAWINGS AND MANUALS**

- 21.1 The following drawings shall be supplied for each switchboard.
- 21.2 General arrangement drawing for each type of board showing constructional features and space required in the front for withdrawal of breaker, power and control cable entry points, location of various devices, terminal blocks, cross sectional details, bus bar supports, number of buses, etc. shall be submitted within 15 days from the date of letter of intent for approval.

- 21.3 Foundation plan and anchor hold details including dead load and impact load.
- 21.4 Drawing and data sheet for each component.
- 21.5 Electrical wiring diagram.
- 21.6 Terminal block arrangement drawing for outgoing feeders.
- 21.7 Complete relay technical particulars and recommended settings.
- 21.8 Operation, maintenance and installation manuals, (one set to Consultants).
- 21.9 Technical Catalogues/Leaflets of CTs, meters, lamps, etc. shall be submitted alongwith offer.
- 21.10 The approval of the drawing does not absolve the vendor from his obligation of ensuring proper and correctness of functioning/operation of the system.

## **IC 22. TESTS**

### **22.1 ROUTINE AND TYPE TEST**

- 22.2 Type test certificates and results as per relevant Standards (Specification) for all the equipment offered under the scope of this specification shall be furnished.
- 22.3 All routine tests on all major components shall be made as per relevant specification in the presence of the buyer or his representative.
- 22.3.1 **Inspection:** Inspection of the Switchboards including inspection of wiring and electrical operational tests by the Owner/Architect before dispatch should be arranged by the tenderer. The cost of transport and incidental expenses to be borne by the tenderer. Two weeks clear notice to be given for carrying out the inspection.

### **22.3.2 Dielectric Tests**

- Insulation of the main circuit that is the insulation resistance of each pole to the earth and that between the poles shall be measured.
  - nsulation resistance to earth of all control wiring should be tested with 1000 V megger.
  - Insulation test shall be carried out both before and after high voltage test.
- 22.4 Each switch board will be completely assembled, wired, adjusted and tested for operation under simulated conditions to ensure correctness of wiring and proper functioning of all equipment's.
  - 22.5 All current carrying parts and wiring shall be subjected to a high potential test.

**IC 23. HIGH VOLTAGE TEST**

A high voltage test with 2.5 KV for one minute shall be applied between the pole and earth. Test shall be carried out on each pole in turn with the remaining poles earthed. All units racked in position and the breakers closed. Originals test certificate shall be submitted along with panel.

**IC 24. PACKING AND TRANSPORT**

The switchboards shall be sent to site by Road Transport packed in Wooden Crates. The packing should be of high quality to avoid any damage to the equipment's during transit. They shall be wrapped with polythene sheets before being placed in crates to prevent damage to the finish.

**IC 25. SPECIAL REQUIREMENTS FOR OUTDOOR KIOSK**

This specification shall be followed while fabricating outdoor kiosk. Precautions to be taken in providing a separate weather proof enclosure to bring it in conformity with IP55. This enclosure shall be painted with two coats of primer and epoxy paint to make it weather resistant.

**IC 26. HANDLING:**

Switchgears and all its accessories shall be handled carefully in its upright position as indicated in the packing case. Lifting lugs and jacking pads shall be used for lifting of the switchgear. While using jacking pads utmost care shall be taken in proper application of jacks. Where switchgears is dragged or pulled on sleeper or rollers of the traction eyes provided at the bottom frame shall be used with suitable wire ropes and shackles.

**IC 27. STORAGE:**

Equipments shall be stored under shelter in a well ventilated, dry place and covered by suitable polythene or tarpaulin covers for protection against moisture.

**IC 28. ERECTION:**

Panels shall be installed over a trench. The panels shall be aligned properly and bolted to the flooring by atleast four bolts. The cables shall be terminated into the panel through bottom plate. The panel shall be bonded to the earth by connecting earthing leads to the panel earth bus.

Should finished paint chip off or crinkle during transit / handling/ installation, the Contractor shall arrange for repainting the equipment at site at his own cost.

**IC 29. TESTS:**

The following preliminary checks and pre-commissioning tests shall be carried out before commissioning the Switchgears in the presence of Buyer/Architect's representatives.

**29.1 PRELIMINARY CHECKS:**

- 29.1.1 Check name plate details according to specification.
- 29.1.2 Check for physical damage.
- 29.1.3 Check tightness of all bolts, clamps and connecting terminals.
- 29.1.4 Check oil level, air pressure and leakage (wherever applicable).
- 29.1.5 Check earth connection.
- 29.1.6 Check cleanliness of insulators and bushings, arc chambers.
- 29.1.7 Check all moving parts are properly cleaned and lubricated.
- 29.1.8 Check space heaters provided.

**29.2 PRECOMMISSIONING CHECKS:**

- 29.2.1 Check alignment of breaker trucks for free movement. Check correct operation of shutters.
- 29.2.2 Slow closing/opening operation.
- 29.2.3 Check control wiring for correctness of connections, continuity and IR values.
- 29.2.4 Manual operation of breakers.
- 29.2.5 **ower** closing/opening operation manually and electrically.
- 29.2.6 Breaker closing and tripping time.
- 29.2.7 Trip free and antipumping operation.
- 29.2.8 I.R. values, resistance and minimum pick up voltage of coils.
- 29.2.9 Contact resistance.
- 29.2.10 Simultaneous closing of all three phases.
- 29.2.11 Pole discrepancy tests.
- 29.2.12 Single and three phase auto-reclose operation.
- 29.2.13 Check electrical and mechanical interlocks provided.
- 29.2.14 Check on spring charging motor correct operation of limit switches and time of charging.

29.2.15 Check on C.Ts.

29.2.16 All functional checks with the relays, meters, alarm scheme, interlock as per scheme with primary injection kits.

29.2.17 High voltage tests on Control and Power Circuits (2.5 KV).

**IC 30. SPECIAL REQUIREMENTS FOR OUTDOOR KIOSK:**

This specification shall be followed while fabricating outdoor Kiosk. Precautions to be taken in providing a separate weather proof enclosure to bring it in conformity with IP 55. This enclosure shall be painted with two coats of primer and epoxy paint to make it weather resistant.

**IC 31. GUARANTEE:**

The contractor shall give guarantee for the supplied equipment for a period of 12 months from the date of commissioning or 18 months from the date of supply of the equipment.

**IC2. SPECIFICATIONS FOR ERECTION, TESTING & COMMISSIONING OF 415 VOLTS SWITCHGEARS****IC 1. SCOPE**

Receiving Inspection, Unloading Storage, Installation, Testing and Commissioning of the Switchgears shall be in accordance with the specified code of practice and manufacturer's instructions. The panels shall be aligned properly and bolted to the flooring by at least four bolts for each division of Transport. The cable shall be terminated into the panel through glands fixed to bottom /top plate. The panel shall be bonded to the earth by connecting leads to the panel earth bus.

**IC 2. HANDLING/UNLOADING**

Switchgears and all its accessories shall be handled/unloaded carefully in its upright position as indicated in the packing case. Lifting lugs and jacking pads shall be used for lifting of the switchgear. While using jacking pads utmost care shall be taken in proper application of jacks. Where switchgears is dragged or pulled on sleeper or rollers of the traction eyes provided at the bottom frame shall be used with suitable wire ropes and shackles. Unloading from the lorry shall be carried out using a mobile crane or tripod with chain pulley block or rolling over to a platform.

**IC 3. STORAGE**

Equipment's shall be stored under shelter in a well ventilated, dry place and covered by suitable polythene or tarpaulin covers for protection against moisture.

**IC 4. ERECTION**

Panels shall be installed over a trench. The panels shall be aligned properly and bolted to the flooring by at least four bolts. The cables shall be terminated into the panel through bottom plate. The panel shall be bonded to the earth by connecting earthing leads to the panel earth bus.

**IC 5. TESTS**

The following preliminary checks and Precommissioning tests shall be carried out before commissioning the Switchgears in the presence of Buyer/Architect's representatives.

**5.1.0 PRELIMINARY CHECKS**

5.1.1 Check name plate details according to specification.

5.1.2 Check for physical damage.

5.1.3 Check tightness of all bolts, clamps and connecting terminals.

- 5.1.4 Check oil level air pressure and leakage (wherever applicable)
  - 5.1.5 Check earth connections.
  - 5.1.6 Check the cleanliness of insulators and bushings,arc chambers.
  - 5.1.7 Check that all moving parts are properly cleaned and lubricated.
  - 5.1.8 Check if space heaters provided.
  - 5.2.0 **PRECOMMISSIONING CHECKS**
  - 5.2.1 Check alignment of breaker trucks for free movement.Check correct operation of shutters.
  - 5.2.2 Slow-closing/opening operation.
  - 5.2.3 Check control wiring for correctness of connections,continuity and IR values.
  - 5.2.4 Manual operation of breakers.
  - 5.2.5 Power closing/opening operation manually and electrically.
  - 5.2.6 Breaker closing and tripping time.
  - 5.2.7 Trip free and antipumping operation.
  - 5.2.8 I.R.Values,resistance and minimum pick up voltage of coils.
  - 5.2.9 Contact resistance.
  - 5.2.10 Simultaneous closing of all three phases.
  - 5.2.11 Pole discrepancy tests.
  - 5.2.12 Single and three phase auto-reclose operation.
  - 5.2.13 Check electrical and mechanical interlocks provided.
  - 5.2.14 Check on spring charging motor correct operation of limit switches and time of charging.
  - 5.2.15 Check on C.Ts
  - 5.2.16 All functional checks with the relays,meters,Alarm Scheme,interlock as per scheme with primary injection kits.
  - 5.2.17 High voltage tests on Control and Power circuits (2.5 KV)
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**ID. SPECIFICATION FOR POWER AND LIGHTING DISTRIBUTION BOARDS****ID 1. GENERAL**

This specification is applicable to 415 Volts, 3 phase 4 wire A.C supply and shall conform to the following Indian Standards (Latest Version).

IS-8623 - Factory built assemblies of switch gear and control gear for voltages upto and including 1000 V AC and 1200 V DC.

IS-8828 - Miniature circuit breakers for voltages not exceeding 1000 Volts.

IS-2675 - Specification for enclosed distribution fuse boards and cut outs for voltage not exceeding 1000 Volts.

IS-2208 - HRC cartridge fuse links 650 Volts.

IS-732 - Code of practice for electrical wiring installation.

**ID 2. TYPE AND CONSTRUCTION**

Distribution boards shall be made of Robust and rigid construction and of totally enclosed dead front safety type. The enclosures shall be made of MS sheet steel of not less than 16 gauge. The sheet steel shall be treated with a rigorous rust inhabitation process before fabrication, followed by two coats of red oxide primer and two coats of synthetic enamel paint of approved shade. The distribution boards shall comprise of switch fuse unit or miniature circuit breakers as incoming and required number of circuit breakers or HRC fuses as outgoing.

The main switch and outgoing shall have rating as specified in the drawings and schedule. The boards shall be designed to have adequate cabling space for either top or bottom entry of both incoming and outgoing cables. Earthing sockets should be fitted to the casing of D.B.

**ID 3. BUS BARS**

Suitable colour coded bus bars made of high conductivity aluminium strips and mounted on non-hygroscopic insulating supports shall be provided. Neutral bus bars shall be of half the size of phase bus bar. The earth bus shall be also provided of material and size as required.

**ID 4. MINIATURE CIRCUIT BREAKERS**

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Miniature circuit breakers shall have a minimum breaking capacity of 9 KA. Circuit breakers shall be equipped with individual insulated, braced and protected connectors. The front face of all the breakers shall be flush with each other. The breakers shall have 'quick break trip free' mechanism with current limiting and overload and short circuit tripping characteristics.

The mechanism shall be such that the circuit can not be held closed when a fault occurs or persists.

The contacts shall be silver tungsten or other suitable material to give long contact life. Multiple units shall have an intertripping mechanism thereby ensuring complete isolation in

the circuit in the event of an overload or fault in anyone of the phases. The connectors shall be suitably shrouded.

**ID 5. FUSES**

Rating of the fuses and carriers shall be as per drawings and schedule of quantities. Fuse carriers and bases shall be best grade phenolic moldings. They shall be non-inflammable and non-hygroscopic, with hard gloss finish. HRC fuses shall have non-deteriorating type characteristics. It shall be link type with rupturing capacity of not less than 35 MVA at 440 V.

**ID 6. SAFETY & INTERLOCKS**

All the live parts be shrouded such that accidental contacts with live parts are totally avoided. Distribution boards shall be provided with a front hinged door. Distribution boards interior assembly shall be dead front with the front cover removed. Main lugs shall be shrouded. Suitable insulating barrier made of arc resistant material shall be provided for phase separation. Ends of the bus structures shall also be shrouded.

**ID 7. CABINET DESIGN**

The distribution board cabinet shall be totally enclosed type with dust and vermin proof construction. The interior surface shall be finished to a off-white shade. The interior components shall be mounted on a separate sheet which is mounted and locked on to the studs provided inside the cabinet. Over this, a cover made of hylam sheet or sheet steel shall be provided with slots equipped with a front door with hinges on one side. Cabinets shall have undrilled detachable glands plates at both top and bottom and sides. The door should be secured by robust fasteners enabling dust protection gasket to be compressed quickly and easily. Unless specified otherwise boards shall be flush mounted in walls.

**ID 8. TERMINALS**

Distribution boards shall be provided with a terminal block of adequate size to receive mains incoming cable and outgoing circuits. The location of the terminal block shall be so located that crowding of wires in the proximity of live parts is avoided. A neutral link having rating equal to that of phase bus shall be provided.

**ID 9. DIRECTORY**

Distribution boards shall be provided with a directory indicating the description of loads served by such circuit breaker, the rating of breakers, size of conductors, etc. The directory shall be mounted in metal holder with a clear plastic sheet on inside surface of the front door. The DBs shall be provided with inscription plates. The size of letters shall be as approved and the wordings for inscription shall be given by Project Manager/Architects.

**ID 10. INSTALLATION**

Distribution boards shall be surface mounted or recessed mounted as required by the Consultants and at the locations shown on the drawings. The boards shall be fixed with suitable angle iron clamps and bolts. All the cables/conduits shall be properly terminated using glands/grips/checknuts, etc. Wiring shall be terminated properly using crimping/lugs

sockets and PVC identification ferrules. The DBs shall be installed as specified in IS 732 and National Building Code.

**ID 11. FASTENERS**

All the screws, nuts, bolts, washers, etc. used for the current carrying parts shall be of brass or other approved non-ferrous material. Other fasteners shall be made of non-corroding materials. The screws used for fixing the top plate and the washers shall be of MS with nickel-plated.

**ID 12. TESTING**

Distribution boards shall be tested at factory as per Indian Standard. The tests shall include insulation test, high voltage test, etc. Distribution boards shall be tested for insulation resistance after the erection.

**ID 13. DRAWING APPROVAL:**

The contractor shall submit the drawings for approval before fabrication.

**IE. SPECIFICATIONS FOR DISTRIBUTION SYSTEM, CONDUITS, WIRING & ACCESSORIES****IE 1. GENERAL**

This Specification of Medium Voltage Distribution System shall be applicable for wiring 3 phase, 4 wire 415 Volts, 50 Hz AC and single phase, 2 wire 230 Volts, 50 Hz, AC supply.

**IE 2. RIGID STEEL/PVC CONDUITS & ACCESSORIES**

2.1 MS conduits shall be of welded and screwed sheet steel construction. Conduits shall be black stove enameled inside and outside. The conduits shall conform to the requirements of relevant IS (latest edition) in all respects. The conduits shall have uniform wall thickness/cross section throughout. Conduits shall bear the name, trademark of the manufacturer and size of conduit on each length. The conduits shall be delivered to the site in original bundles. Conduits of **less than 19 mm dia. shall not be used**. The minimum wall thickness of conduits shall be as follows: -

Rigid M.S Conduits : a) 19,25 & 32 mm - 16 gauge.  
: b) 38 mm & above - 14 gauge.

Rigid PVC Conduits - 2 mm. (Heavy Duty)

2.2 **Conduit Accessories** : Conduit accessories such as bends, inspection bends, inspection tees, elbows, reducers, draw boxes, junction boxes, etc. shall be of approved makes. Boxes shall have internally tapped spouts, junction boxes/inspection boxes shall be internally tapped table covers. Necessary pull boxes of adequate sizes shall be provided wherever required at no extra cost.

2.3 All conduits shall be of ample size for easy 'draw in' and 'draw out' of all the wires in the conduits. In no case the total cross section of wires measured over all be more than forty percent of the area of the conduit.

2.4 All the conduits shall be adequately protected while stored on site prior to erection and no damaged conduit shall be used.

2.5 All conduit accessories shall be made out of 16 Gauge thick MS enclosures..

**IE 3. PREPARATION OF CONDUIT :**

The inside surface and ends of conduits and threads and fittings used shall be clean, smooth, cut square and free from burrs and other defects. Powdered soap stone, talc or prepared compounds shall be used as lubricants to facilitate the smooth pulling in of conductors.

**IE 4. ERECTION OF CONDUIT**

4.1 The conduit shall be properly and tightly screwed between the various lengths and to the boxes to which it runs and terminates. No part of the conduit shall be under

mechanical stress and the whole conduit system shall be electrically and mechanically continuous throughout.

4.2 Conduits shall be installed with provision for ventilation self drainage in the event of ingress of moisture due to condensation or any other reason and prevent sweating.

4.3 A suitable drainage hole shall be drilled in the bottom of the lowest conduit box in every 9 Mtrs. of horizontal length.

#### **IE 5. INSTALLATION OF RECESSED CONDUIT SYSTEM**

5.1 The conduits shall be installed in such a manner that running can be carried out from the fittings boxes and switch boxes only.

5.2 Conduits which are to be taken in the ceiling slab shall be laid on the prepared shuttering work of the ceiling slab before concrete is poured, and tied to bars at every 500 mm. The conduits shall be made water-tight by using bituminous compound at the screwed ends. The conduits in ceiling slab shall be straight as far as possible.

5.3 Conduits recessed in walls shall be secured rigidly by means of steel hooks/staples at 0.8 mtrs. intervals. Before conduit is concealed in the walls, all chases, grooves shall be neatly made to proper dimensions to accommodate the required number of conduits.

The outlet boxes, point control boxes, inspection and draw boxes shall be securely fixed by means of counter sunk steel screws and rawl plugs. They shall be firmly grouted in position prior to plastering fixed as and when conduit is being laid. The recessing of conduits in walls shall be so arranged as to allow atleast 12 mm plaster cover on the same. All grooves, chases, etc. shall be refilled with cement mortar and finished upto the wall surface before plastering of walls is taken up by the general contractor. The top edge of the conduit shall be atleast 25 mm below the finished surface of wall. Wherever conduits terminate into point control boxes, distribution boards, etc. conduits shall be rigidly connected to the boxes, boards, etc. with checknuts on either side of the entry to ensure electrical continuity.

5.4 After conduits, junction boxes, outlet boxes, etc. fixed in position their outlets shall be properly plugged with PVC stoppers or with any other suitable materials so that water, mortar, vermin's or any other foreign material do not enter into the conduit system.

5.5 To facilitate easy drawing of wires in conduit necessary GI pull wires of 16 SWG shall be inserted into the conduit immediately after shuttering is removed.

**5.6 The Electrical Contractor shall be present during the pouring of concrete to ensure that the conduits and accessories are not displaced or blocked.**

5.7 The conduits shall be swabbed out by drawing dry swabs of rag through the conduit to remove all moisture prior to drawing of wires.

5.8 Where vertical concealed conduits pass through floors or beams and horizontal concealed conduits required to pass through columns or beams, these shall be taken through rigid

PVC/GI pipes to be inserted in the floors /columns/beams, etc. during casting for which no extra payment shall be entertained.

- 5.9 Extension collars of suitable depth shall be used as necessary to leave all boxes absolutely flush with the finished wall or ceiling surface.
- 5.10 Conduits shall not be buried or plastered etc. unless and until the work has been inspected by the Owner/ Architects.

#### **IE 6. INSTALLATION OF SURFACE CONDUIT SYSTEM**

- 6.0 Conduits shall run in square and symmetrical lines. Before the conduits are installed, the exact routes shall be marked at site and approval of the Architect shall be obtained. Conduits shall be fixed by heavy gauge GI base plates, saddles, secured to suitable rawl plugs, at an interval of not more than 1 Mtr. Conduits shall be joined by means of screwed couplers and screwed accessories only. In long distance straight runs of conduit, inspection type couplers or running type couplers or pull boxes shall be provided.

6.1 Bends in conduit runs shall be done by bending conduits by pipe bending machine. Bends which cannot be negotiated by pipe bends, shall be accompanied by introducing inspection boxes or inspection bends. Not more than three equivalent 90 C bends shall be used in a conduit run from outlet to outlet.

6.2 All the conduit openings shall be properly plugged with PVC stoppers/bushes. The conduits shall be adequately protected against rust by applying two coats of approved synthetic enamel paint after the installation is completed.

6.3 Wherever conduits terminate conduits shall be rigidly connected to the box/board with brass hexagonal checknuts with compression washers on either side of the entry to ensure proper electrical and mechanical continuity.

6.4 The crossing of surface conduits shall not be generally permitted and to avoid such crossings, adopter boxes shall be used at junctions/crossings.

6.5 All unused conduit entries shall be blanked off in an approved and where conduits terminate in adopter boxes. All removable box covers shall be firmly secured to provide complete enclosure.

#### **IE 7. CONDUITS ABOVE FALSE CEILING**

- 7.1 In the false ceiling area, the conduits shall be run above the false ceiling frame work supported by means of M.S straps secured and fixed to both conduits and structural ceiling, keeping the outlet box as near as possible to the fittings/fans for connections. The conduit boxes for fittings/fans are independently supported by means of separate fixing arrangements to the box and structural ceiling so that the box is held rigidly.

#### **IE 8. ENCLOSURE FOR ELECTRICAL ACCESSORIES**

- 8.1 Enclosure for electrical accessories shall conform to IS:5133-Part I. The wall thickness of MS enclosures shall be not less than 1.6 mm. The enclosure boxes shall be provided with a minimum of four fixing lugs located at the corners for fixing the covers. All fixing lugs shall have tapped holes to take machined brass screws.
- 8.2 Sufficient number of knockouts shall be provided for conduit entries. The enclosures shall be adequately protected against rust or corrosion both inside and outside. The enclosures shall be provided with 5 mm thick overlapped white PVC or perspex sheet cover with rounded corners and beveled edges for mounting switches, sockets etc. Wherever different phase conductors are brought into the same enclosure, phase barriers shall be provided.
- 8.3 Minimum size of the box shall be 75 x 75 x 75 mm.
- 8.4 Draw boxes of ample dimension shall be provided at convenient points on walls/ceilings to facilitate pulling of long runs of wire. These boxes will be as few as possible and located where found necessary and approved by Architects at no extra cost.
- 8.5 Where flush conduits are required to terminate at surface mounted equipment, the conduit shall terminate at a flush box and the back of the equipment should fully cover the flush box and brass screws shall be used between the equipment and the box in addition to any other means of fixing and earthing arrangement.

The alternative arrangement to the above shall be by means of fixing a terminal extension box to the flush conduit box in which case a break joint ring shall be fitted between boxes.

#### **IE 9. WIRING CONDUCTORS**

- 9.1 All wiring conductors shall be PVC insulated, copper conductors of 1100 V grade, and shall conform to IS:694 Part II (Latest Edition).
- 9.2 Wiring conductors shall be supplied in Red, Blue, Yellow, Black and Green colours for easy identification of wires. The wires shall be supplied in sealed coils of 100 Mtrs. length and shall bear manufacturer's trade mark, name, Voltage grade etc.

#### **IE 10. INSTALLATION OF WIRING CONDUCTORS/CABLES**

- 10.1 The wiring conductors shall not be drawn into the conduits until all the works of any nature that may cause damage to the wires are completed. The installation and termination of wires shall be carried out with due regard to the followings
- 10.1.1 While drawing the wiring conductors, care shall be taken to avoid scratches and kinks which cause breakage of conductors. There shall be no sharp bends in the conduit system.
- 10.1.2 Strands of the wires shall not be cut for connecting to the terminals or lugs. The terminals shall have adequate cross section to take all the strands.
- 10.1.3 Oxide inhibition grease shall be applied at all terminals and connections.

- 10.1.4 Brass flat washers of large area shall be used for bolted terminals.
- 10.1.5 Bimetallic connectors should be used wherever aluminium conductors are tapped from copper mains or vice-versa.
- 10.2 Wiring for power and lighting circuits shall be carried out in separate and distinct wiring systems.
- 10.3 The wiring system envisaged is generally shown on the layout drawings and line diagrams. However, a brief account of the general wiring system is given below :
- 10.3.1 Submains wiring - Wiring from Meterboards/switch boards to the individual distribution boards, and shall consist of wires, conduits, all conduit and fixing accessories as required and specified. The sizes of conduits and number of wires shall be as specified in Schedule of Quantities. Wires shall be drawn in conduits as required without being damaged, with necessary draw boxes if required. The wire lengths must be adequate for terminating at either end and identifying ferrules shall be provided at termination. The wiring shall be colour coded. The rate shall include all materials, connections, labour etc. as specified above.
- 10.3.2 Circuit wiring - Wiring from DBs to the first point control boxes for lighting, fans, 5A sockets, call bells, etc. The scope of work shall be same as in submain wiring.
- 10.3.3 Power wiring: The wiring from DBs to heating supplies, 15 A 3 pin socket outlets, etc. The scope of work shall be same as in sub-main wiring.
- 10.4 Each sub-main/circuit main/power wiring circuit shall also have its own earth continuity wire as specified.
- 10.5 All the wiring shall be carried out in loop-in-loop system only and phase or line conductors shall be looped at switch box and neutral conductor can be looped from light, fan or sockets.
- 10.6 The maximum number of various size conductors that could be drawn into various sizes of conduits shall be as per table II of IS:732 (Latest Edition). The wiring shall be colour coded for easy identification of phases and neutral. The following colour codes shall be adopted.
- Phases - Red, Yellow and Blue.
- Neutral - Black.
- Earth - Green or Bare wire as specified.
- 10.7 All submains and circuit wiring shall be provided with printed PVC identification ferrules at either end bearing the circuit number and designation.

#### **IE 11. SWITCHES, SOCKETS AND ACCESSORIES**



- 11.1 **GENERAL REQUIREMENTS:** General control switches shall be of a 5 A rating and shall be of approved make/type suitable for flush mounting. Switches shall have either integral mounting plates or white PVC/perspex of min. 4.5 mm thick.
- 11.2 All sockets, 5A and 15A ratings shall be of flush mounting type with combined control switches of the same rating as that of the sockets. All sockets outlet shall be of 3 pin type.
- 11.2.1 The switch, plug socket or regulator boxes shall be made of GI/sheet steel of minimum 16 SWG on all sides except in the front. Depth of boxes shall not be less than 75 mm and suitably increased where fan regulators are mounted in flush pattern. The boxes shall be provided with suitable earthing studs. Wherever required switches/fittings shall be fixed on metal strip which in turn are welded to the box.
- 11.3 Fan regulators shall be flush type and earthed with earth continuity conductor. The fan regulator shall be of electronic stepped type.

**IE 12. LAMP HOLDERS, CEILING ROSES, ETC.**

- 12.1 Accessories for light outlets such as lamp holders, ceiling roses, etc. shall be in conformity with requirements of relevant IS specification. Only approved make of accessories shall be supplied.
- 12.1 Screwed holder shall be used in brackets and pendants, light fittings shall have brass holders on T.W. round blocks.
- 12.2 Ceiling roses for recessed system of wiring shall be porcelain make and flush type. For surface type of wiring this shall be Bakelite.

**IE 13. INSTALLATION OF SWITCHES, SOCKETS AND ACCESSORIES**

All the switches shall be wired on phases. Connections shall be made only after testing the wires for continuity, cross, phase etc. with the help of megger. Regulators shall be fixed on adjustable MS flat straps inside the enclosure. The arrangement of switches and sockets shall be neat and systematic. Covers for enclosures accommodating switches, sockets etc. (point control boxes) shall be of 4.5 mm thick, fine finished PVC/perspex material or laminated hylam sheet and fixed to the enclosure in plumb with counter sunk head, chromium plated MS screws and washers. Outlets shall be terminated into a flush type fan box for fan points. For wall plug sockets, the conductors may be terminated directly into the switches and sockets. The outlets point control boxes etc. shall be set out as shown on the drawings. Before fixing these, the contractors shall obtain clearance from the Owner/Architect with regard to their proper locations. The enclosures of sockets/and 3rd pin of the sockets shall be connected to the ground through an earth continuity wires, as specified.

**IE 14. CAPACITY OF CIRCUITS**

- 14.1 Light points, 5A socket points, fans, and call bell points may be wired on a common circuit. Such of those circuits shall not have more than 10 nos. of Light/fan/socket points or a load of 800 W whichever is less. Not more than two numbers of 15A socket outlets shall be wired on the same circuit.

**IE 15. POINT WIRING**

- 15.1 Point wiring shall commence from the first point control box/local control box for the points connected to the same circuit. Point wiring for lights, ceiling and exhaust fans, 5A sockets, call bells etc. shall be carried out with 1100 V Grade PVC insulated wires. The point wiring shall be inclusive of conduits of not less than 19 mm size, switches, wiring alongwith conduit accessories such as bends, inspection bends, reducers, pull boxes, junction boxes, switch boxes, fan boxes, covers etc. together with wiring accessories such as ceiling roses, brass lamp holders, T.W Blocks, loose wires upto 1 Mtr. long at outlet end connectors point control boxes (enclosure for electrical accessories) switches, etc. Point wiring shall be provided with earth continuity wire as specified for earthing 3rd pin of sockets, luminaries and fan fixtures. Light control shall be either single, twin or multiple points controlled by a switch, as specified.

The point wiring for Light/Fans/5A sockets etc. shall include the supply and installation of all materials specified above. Any item not specifically included but required for satisfactory completion of the point wiring shall also be included. No separate extra price will be allowed for any item under point wiring.

A dependent socket point shall mean the combination 5A switch socket outlet/point mounted on the same switchboard as any other point/points and shall include the 5A switch and socket.

The fan point shall be complete with fan hook box flush mounted in slab, control switch mounted in switch box and electronic regulator, complete with cover. The measurement will be numbers of each kind of point and as specified in Schedule of Quantities.

**IE 16. FIXTURES/FANS:****16.1 LIGHT FITTINGS:**

Unless otherwise specified, light fittings shall be generally fixed as directed by Owner/Architects.

- 16.1.1 Fittings such as wall brackets shall be fixed at 2200 mm from FFL.
- 16.1.2 Bulk head fittings shall be flush with ceiling/wall as required and shall be at a height as specified or directed.
- 16.1.3 Pendant fittings shall be suspended to a height of 2400 mm from FFL.
- 16.1.4 The fluorescent fittings shall be fixed in such a manner that the wiring conductors shall not terminate in a ceiling rose but in a junction box 300 mm away from the center of the fitting along the length of the fitting so that no exposed wiring is seen from outside.

**16.2 FANS****16.2.1 CEILING FANS**

Ceiling fans shall be suspended from the special fan hook boxes. The fan wiring shall be terminated in porcelain/PVC multiway connector.

Each fan shall have a separate switch and speed regulator. The canopy at the top of the suspension rod shall effectively hide the suspension hook.

The control switch and the electronic regulator for the fan shall be included in the point wiring.

## **IE 17. TESTING OF ELECTRICAL INSTALLATION**

### **17.1 TESTING OF INSTALLATION SHALL BE AS PER IS 732-1982**

- 17.1.1 The insulation resistance shall be measured by applying between earth and whole system of conductors of any section thereof with all fuses in place and all switches closed and except in earthed concentric wiring all lamps in position or both poles of the installation otherwise electrically connected together, where a direct current pressure of not less than twice the working pressure provided that it need not exceed 500 Volts for medium voltage circuits. Where the supply is derived from the three wire (A.C or D.C) or a poly phase system, the neutral pole of which is connected to earth either direct or through added resistance, the working pressure shall be deemed to be that which is maintained between the outer or phase conductor and neutral.
- 17.1.2 The insulation resistance measured as above shall not be less than 50 megohms divided by the number or points on the circuits provided that the whole installation shall be required to have an insulation resistance greater than one megohm.
- 17.1.3 Control rheostats, heating and power appliances and electric signs may, if required be disconnected from the circuit during the test but in the event of the insulation resistance between the case or frame work and all live parts of each rheostat appliances and all live parts of each rheostat and sign shall be less than that specified in the relevant Indian Standard Specification or where there is no such specification shall not be less than half a megohm.
- 17.1.4 The insulation resistance shall also be measured between all conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or the neutral or to the other pole or phase conductors of the supply and its value shall not be less than specified in sub-clause 17.1.2.

### **17.2 TESTING OF EARTH CONTINUITY PATH**

The earth continuity conductor including metal conduits and metallic envelopes in all cases shall be tested for electrical continuity and the electrical resistance of the same alongwith the earthing lead but excluding any added resistance or earth leakage circuit breaker measured from the connection with the earth electrodes to any point in the earth continuity conductor

in the completed installation shall not exceed one ohm. For checking the efficiency of earthing, the earth resistance of each earth electrode shall also be measured. This test shall preferably be done during summer months.

### **17.3 TESTING OF POLARITY OF NON-LINKED SINGLE POLE SWITCHES**

In a two wire installation, a test shall be made to verify that all non-linked, single pole switches have been fitted in the same conductor throughout and that such conductor has been connected to an outer or phase conductor or to the non-earthed conductor of the supply.

- 17.4 The contractor shall be responsible for providing the necessary instruments and subsidiary earth for carrying out the tests. The earth coordinating tests shall comply with the IS specifications as may be applicable. Should the above tests not complete with the limits laid down, the contractors shall do the necessary rectification of the fault till the required results are obtained.

## **IF. SPECIFICATION FOR DUMMY CONDUITS, FOR COMMUNICATION & DATA SYSTEM**

The conduits for the telephone system as well as Intercom System and Data System shall be same as explained and specified elsewhere for other work. The minimum size of conduits used for Telephone System/Intercom shall be of 19 mm dia.

All distribution boxes shall be flush mounting, flat fronted, 16 Gauge sheet steel enclosed boxes flush with wall and properly joined to conduits. The distribution boxes shall incorporate terminal strips of the combined soldering screw type/tag blocks as required.

The telephone outlet boxes made of 16 Gauge sheet steel shall be of minimum 75 x 75 x 75 mm. These shall be flush mounting type installed with an approved cover matching with all other outlets in the electrical system and consisting of a CAT 5 RJ 45 outlet and approved by the structured data and communication cabling system.

The telephone boxes shall be generally mounted at 450 mm FFL unless otherwise specified/indicated in drawing.

The contractor shall consult and co-operate with the telephone department when installing the telephone wiring and conduit system and shall abide by their requirements, rules and regulations, shall furnish all work and material to secure their approval of the completed installation.

Detailed drawings showing the telephone terminal and junction boxes fabricated in accordance with above requirements shall be submitted by the contractor for approval to the telephone department and the Architects.

Rates shall include a GI fish wire left in the conduit to draw telephone wires. The end of conduit shall be sealed to prevent dirt, dust, mortar or any foreign matter going into telephone conduits.

The telephone indoor wires shall be 0.5 mm annealed tinned copper conductor, PVC insulated, twisted into pairs, laid up, taped and overall PVC sheathed, or CAT 5# UTP/STP cable.

The telephone outdoor cable shall be 0.5 mm annealed copper conductor, polythene insulated, colour coded, twisted into pairs, laid up, jelly filled with petroleum jelly compound, wrapped with non-hygroscopic tape under moisture barrier poly-al-laminated foil tape and embedded with water proof polythene material.

**IG. SPECIFICATION FOR LOW TENSION CABLES****IG 1. SCOPE**

This specification covers the technical requirements of supply, laying, testing and commissioning of Heavy duty medium voltage cables upto 1100 Volts for power, control and lighting application for efficient and trouble free operation.

The cable shall be properly packed for transportation, supply and delivery at site.

**IG 2. CODE AND STANDARDS**

The materials covered by this specification shall unless otherwise stated as designed, constructed, manufactured and tested in accordance with latest revisions of the relevant Indian Standards.

IS 1554 (Part I)- 1988 : PVC insulated cables for working voltages upto and including 1000 V.

IS 5831 - 1984 : PVC insulation & sheath of electric cables.

IS 8130 - 1984 : Conductors for insulated electrical cables.

IS 3961 (Part II) - 1977 : Recommended current ratings for PVC insulated and PVC sheathed heavy duty cables.

**IG 3. RATING**

The cable shall be rated for a voltage rating of 650/1100 Volts.

**IG 4. SELECTION OF CABLES:**

Cables should be selected considering the conditions of maximum connected load, ambient temperature, grouping factor, allowance for voltage drops. However it is the responsibility of the contractor to recheck the sizes before cables are procured. He should submit the cable derating, voltage drop and length calculation to Architects for approval before procuring cables.

**IG 5. INSULATION:**

The conductor is insulated with suitably compounded PVC applied to the conductor by the extrusion.

The PVC compound used for insulation shall have reduced flame propagation property. This shall also have reduced emission of hydrogen-chloride gas fumes etc. when severely overheated during fires.

**IG 6. CORE IDENTIFICATION:**

The cores of the cables shall be provided with the colour scheme of PVC insulation as per IS for any easy identification.

**IG 7. ARMOURING:**

The armoring of multicore cable consists of either GI round steel wires or GI flat strips and in case of single core cable armoring shall be of non-magnetic material such as hard drawn aluminium or aluminium alloy wires or strips.

**IG 8. OUTER SHEATH:**

The PVC compound used for outer sheath shall be resistant to termites, fungus and rodent attacks and shall also have reduced flame propagation property as specified above.

**IG 9. IDENTIFICATION:**

The manufacturer's name, voltage grade of cable, year of manufacture, nominal cross-sectional area of conductor shall be embossed on the outer sheath of the cables throughout the length of the cable at regular intervals.

**IG10. PACKING, MARKING AND TRANSPORT:**

The cables shall be supplied in strong, non-returnable wooden drums of heavy construction.

Each cable drum is marked with particulars of cable size, voltage class, length, direction of rolling, position of outer gross weight, ISI certification marking etc.

**IG11 STORING, LAYING, JOINTING AND TERMINATIONS:****11.1 STORING:**

All the cables shall be supplied in drums, on receipt of cables at site, the cables shall be inspected and stored in drums with flanges of the cable drum in vertical position.

Employer/Architects will inspect the cables before storing. Contractor shall take out samples from the drums as per their instructions and send them to the manufacturers to conduct the approval tests. After the receipt of the test analysis, the cable will be accepted by the Employer.

**11.2 LAYING:**

Cables shall be laid as per the specification given below :

**11.2.1 Cables in Outdoor Trenches:**

Cables shall be laid in outdoor trenches wherever called for. The depth of the trenches shall not be less than 75 cms. from the Formed Ground Level (FGL) which has to be ascertained

from the Architects. The width of the trenches shall not be less than 45 cms. A spacing of not less than the cable diameter shall be allowed between the cables. The trenches shall be cut square with vertical side walls and with uniform depth. Suitable shoring and propping

may be done to avoid caving in of trench walls. The floor of the trench shall be rammed level. Cable unreeling from drums shall be done only with the help of cable drum rolling supports. The cables shall be laid in trenches over the rollers placed inside the trench. The cable drum shall be rolled in the direction of the arrow for rolling. Wherever cables are bent, the minimum bending radius shall not be less than 12 times the diameter of the cable. 15 cms thick layer of sand cushioning to be provided full of stones and pebbles. Cable shall be taken lifted and placed over this and cushion. The cable shall then be covered with a 15 cms thick sand cushion, where cable is laid in rocky situation. Extra thick cushioning of sand as may be required/decided by the Project Manager/Architects shall be done without extra charge. Over this, a course of cable protection tiles or brick shall be provided to cover the cables by 5 cms on either side. Unless otherwise specified, the cable shall be protected by concrete tiles/stone slabs of minimum 25 mm thick placed on top of the trench breadthwise for the full length of the cable. Trench shall be back filled with earth and consolidated. Cables shall be laid in hume pipes at all road crossings and in GI pipes / PVC pipes at the wall entries. Approved cable markers made of concrete blocks indicating the voltage grade and the direction of run of the cables shall be installed at regular intervals of 25 Mtrs. The depth of concrete blocks shall be at least 300 mm below ground and 50 mm above ground.

#### **11.2.2 Cables in Indoor Trenches:**

- 11.2.3 Cables shall be laid in indoor trenches wherever specified. Suitable painted MS base plate clamps, saddles, GI nuts/bolts or alternatively UV resistant tie wraps shall be used for securing the cables in position at an interval not more than 450 mm. Spacing between the cables shall not be less than 15 mm center to center. Wherever specified, trenches shall be filled with fine sand and covered with steel chequered trench covers or RCC slabs.
- 11.2.4 All chases and passage if necessary for the laying of service cables at the entry or of premises shall have to be cut and made good to the satisfaction of the Project Manager/ Consultants.
- 11.2.5 All cables entries into the buildings/cable trenches/ducts, etc. shall be suitably sealed as required by the Project Manager/Consultants without extra cost.

#### **IG12 JOINTING AND END TERMINATIONS:**

Cable jointing shall be done as per the recommendations of the cable manufacturer. Jointing shall be done by qualified cable jointer under strict supervision. Sample crimping of different size cables shall be subjected to contact resistance and heating tests in the presence of the Architects.

Each termination shall be carried out using Electroplated Brass double compression glands and copper cable sockets and approved jointing materials are to be used. Hydraulic crimping tool shall be used for making the end termination's. Cable gland shall be bonded to the earth by using suitable copper wire with earth tag's. The cable armoring is to be earthed properly so



that the earth continuity is maintained. All outdoor terminations shall be provided with PVC shroud's to make them water vermin proof.

**IG13 TESTING:**

- 13.1 Cables shall be tested at factory as per the regulations of IS:1554 Part I. The tests shall incorporate routine tests, type tests and acceptance tests. Copy of such test certificates shall be furnished to the Owner.
- 13.2 Cables shall be tested at site after installation and results shall be submitted to Consultants/Engineers.
- 13.3 Insulation resistance between conductors and neutral and conductors and earth.

## **IH. SPECIFICATION FOR EARTHING SYSTEM**

### **IH 1.0 SCOPE**

This specification covers the requirements of supply, installation, testing and commissioning of earthing systems. The work shall be carried out in accordance with typical drawings (shall be submitted by contractor within 30 days of awarding contract) and installation notes etc. All metal conduits, cable sheathes, switchgear, distribution boards, light fixtures, fan and all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to earth electrodes.

### **IH 2.0 CODES AND STANDARDS**

- 2.1 The earthing systems shall comply with all currently applicable standards, regulations and safety codes of the locality where the installation is to be carried out. Nothing in this specification shall be construed to relieve the Contractor of this responsibility.
- 2.2 The installation work shall conform to the latest applicable Electricity Rules, Relevant Indian Standards and Codes of Practices as follows :
  - 2.2.1 IS 3043 - Code of Practice for Earthing.
  - 2.2.2 IS 732 - Electrical Wiring Installation.
  - 2.2.3 IS 3975 - Galvanized round steel wire.
  - 2.2.4 Indian Electricity Rules 32, 61, 67 and 68 of IER 1956.

### **IH 3.0 EARTHING ELECTRODES**

- 3.1 Earthing electrodes shall be designed as per the requirements of IS 3043. The resistance of earth electrodes shall be as low as possible, **the maximum allowable value being one Ohm.**

Earth electrodes shall be as far as possible embedded below permanent moisture level. Earth pits shall be further treated with salt and charcoal to improve the soil resistivity. In rocky areas where the required earth resistance cannot be attained using the standard earth electrode. Configuration then application of deep well earth pits should be examined.

### **3.2 PLATE ELECTRODE**

Plate electrodes shall be made of copper plate of 3.15 mm thick and 600 x 600 mm size. The plate shall be buried vertically in ground at a depth of not less than 2.5 Mtrs. to the top of the plate, the plate being encased in powdered charcoal to a thickness of 15 Cms. around. Salt and river sand shall not be used. Earth leads to the electrode shall be laid in a medium grade GI pipe and connected to the plate electrode with brass bolts, nuts and washers. The GI pipe of 19 mm dia. shall be placed vertically over the plate and terminated in a funnel of 5 Cms above the ground. The funnel shall be enclosed in masonry precast chamber. The chamber

shall be provided with CI frame and CI cover. The earth station shall also be provided with a suitable permanent identification label/tag.

### 3.3 **PIPE ELECTRODE**

Pipe electrode shall comprise of 50 mm dia. GI pipe with wall thickness 3.65 mm and not less than 3.0 mtrs long buried vertically in a pit of 350x350 mm size and filled with alternate layers of charcoal, salt and river sand and connected at the top to a medium grade GI pipe of 19 mm dia, 1 mtr long with a funnel at the other end, clamped to the pipe electrode with brass bolts, nuts and washers. GI pipe electrodes shall be cut tapered at the bottom and provided with holes of 12 mm dia. drilled not less than 75mm from each other upto 2 Mtrs., length from bottom. The top end of the pipe shall be threaded and provided with G.I cap. A hole shall be provided at 100 mm from the top end to receive a 13 mm bolt with double nuts and washers. The funnel and the earth lead connections shall be enclosed in a masonry precast chamber/inspection pit. The chamber shall be provided with C.I frame and C.I cover. A proper permanent identification tag/label/earth cable marker shall be provided for each electrode.

## IH 4.0 **EARTHING SYSTEM**

### 4.1 **GENERAL**

Each installation shall have one common earth grid connected to atleast two groups of earth electrodes.

The earth grid shall extend throughout the installation in the form of a ring circuit with branch connections to the equipment and structures to be earthed.

### 4.2 **EARTHING CABLES AND CONNECTIONS :**

Earth systems shall be of solid copper/galvanized flats type, of cross-section specified on the relevant design earth layout drawing.

Connections between earth electrodes and main ring earth conductors shall be executed in accordance with Electrical Drawings and in such a way as to facilitate the inspection and testing the earth resistance of each individual earth electrode group without disconnection of the earth system main ring.

All uninsulated parts of earth conductors shall be suitably protected against direct contact with the soil to prevent electrolytic corrosion. This may be achieved by lap wrapping bared sections with green PVC adhesive tape.

All earthing termination's shall be made with compression type cable lugs. Interconnections shall be directly clamped with compression type branch connectors as detailed in Electrical Drawings.

Execution of earth cable branch connection by means of exothermic welding shall require the approval of The Company Site Representative, who will take into account the suitability of the welding equipment and the previous experience of the Contractor's personnel.

The resistance between each earth electrode configuration and the general mass of earth shall not exceed 5 ohms when isolated from the main earth grid.

Location of earth electrodes, earth conductors connections and earth cable routes shown on the installation earth layout drawing shall be considered as diagramatic only, and site inspection shall be necessary to determine earth connection onto equipment's locations and conductor routes prior to installation.

Within buildings, strips of high conductivity copper/GI, sized in accordance with the layout earthing design drawing, should be utilized.

Where copper tape or cable is fixed to building structure it shall be by means of purpose made saddles.

Fixings shall be made using purpose made lugs and clamps.

Fixings requiring drilling of holes through stripes shall be used, considering the effective cross-section of the particular run is within relevant regulations.

Where tape or cable is run in the ground or fixed externally, and is liable to corrosion, it shall be wrapped with corrosion-resistant material. Alternatively, PVC wrapped tape or cable may be used.

Joints in copper tape shall be tinned before assembly, riveted with a minimum of two rivets, and sweated solid.

Where holes are drilled in the earth tape for connection to items of equipment, effective cross-sectional area of connections shall be not less than required to comply with the relevant Regulations.

Bolts, nuts and washers for any fixings of earth tape shall be of high-tensile grade.

#### 4.3 **ELECTRICAL EQUIPMENT**

Metallic enclosures of all electrical equipment shall be earthed at two ends by connection to the common earth grid.

Cross-sectional area of the equipment earth connections shall be in accordance with the earth layout design drawing.

#### 4.4 **NON-ELECTRICAL EQUIPMENT**

All metallic equipment used for storage, processing, transportation or pumping flammable liquids, vapours or gases, and their associated supporting structure or skid, shall be electrically bonded to the installation main earth ring.

Electrical bonding of associated metal work, in handrails, walkways, etc., is not necessary if it is demonstrated by testing that they are electrically continuous with the structure. However, the same shall be bonded to earth at one point.

Piping which is not in electrical contact with its associated tank or vessel, such as an open discharge line into a tank, shall be bonded to the tank.

In installations that do not contain electrical equipment, the resistance between each earth electrode configuration and the general mass of earth shall not exceed 5 ohms when isolated from the main earth grid.

#### 4.5 **BONDING**

Metal sheaths and armour of all cables operating at low voltage, metal conduits, ducting, trunking, and protective conductors associated with such cables, which might otherwise come into contact with adjacent fixed metalwork, shall be effectively either segregated from, or bonded to, adjacent metal work.

Metallic sheaths and / or non-magnetic armour of all single-core cables in the same circuit normally shall be bonded together at one end only of their run (solid bonding) unless specified otherwise.

All interior metal, water and gas piping shall be bonded together and made electrically continuous. Non-conductive coatings (such as paint, lacquer and enamel) on equipment to be earthed shall be removed from threads and other contact surfaces to ensure good electrical continuity.

## **II. TECHNICAL SPECIFICATION FOR LIGHT FITTINGS AND ACCESSORIES**

### **II 1.0 SCOPE:**

This Specification also covers the design, material specification, manufacture, testing at works, inspection and delivery, installation at site of energy efficient - LED type light fittings and their associated accessories.

### **II 2.0 STANDARDS:**

The LED light fittings and their associated accessories such as lamps/tubes, reflector, housings, etc. shall comply with the latest applicable standards. All luminaires, lamps and accessories shall be of same make.

### **II 3.0 GENERAL REQUIREMENTS:**

Fittings shall be designed for continuous trouble-free operation under hot humid atmospheric conditions, at an ambient of 45°C without reduction in lamp life or without deterioration of materials and internal wiring. Outdoor fittings shall be weatherproof and waterproof type.

The fittings shall be designed so as to facilitate easy maintenance, including cleaning, replacement of lamps/starters etc.

Connectors between different components shall be made in such a way that they will not work loose by small vibration.

For each type of light fitting, the Manufacturer/Vendor shall supply the utilisation factor to indicate the proportion of the light emitted by the bare lamp which falls on the working plane.

The fittings shall be supplied complete with lamps.

The fittings and accessories shall be designed to have low temperature rise. The temperature rise above the ambient temperature shall be as indicated in the relevant Standards.

Each fitting shall have a terminal block suitable for loop-in, loop-out T-off connection. The internal wiring shall be completed by the manufacturer by means of stranded Copper wire and terminated on the terminal block.

All hardware used in the luminaires, shall be Cadmium plated.

### **II 4.0 EARTHING:**

Each light fitting shall be provided with an earthing terminal suitable for connection to the earthing conductor.

All metal or metal-enclosed parts of the housing, shall be bonded to the earthing terminal so as to ensure satisfactory earth continuity throughout the fixture.

#### **II 5.0 PAINTING/FINISH:**

All surfaces of the fittings shall be thoroughly cleaned and de-greased. The fittings shall be free from scale, sharp edges and burns.

The housing shall be stove-enamelled/epoxy stove-enamelled /vitreous enamelled powder-coated of anodized as indicated as indicated under various types of fitting.

The finish of the fitting shall be such that no bright spots are produced either by direct light source or by reflection.

#### **II 6.0 ACCESSORIES FOR LIGHT FITTINGS:**

##### **6.1 Reflectors:**

The reflectors shall be made of CRCA sheet steel /Aluminium/Silvered glass as indicated, for the above mentioned fittings.

The thickness of Steel/Aluminium, shall comply with relevant Standards. Reflectors made of Steel, shall have stove-enamelled/Vitreous-enamelled/Epoxy-coating finish.

Aluminium used for reflectors, shall be anodised/Epoxy Stove-enamelled/Mirror polished.

Reflectors shall be free from scratches or blisters and shall have a smooth and glossy surface having an optimum light reflecting co-efficient such as to ensure the overall light output specified by the manufacturer.

Reflectors shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools, they shall be securely fixed to the housing by means of positive fastening device of captive type.

##### **6.2 to 6.5 Blank**

##### **6.6 LAMPS:**

All lamps shall be of energy efficient LED type only.

**IJ. Blank****IK. SPECIFICATIONS FOR MOULDED CASE CIRCUIT BREAKERS (MCCBs)**

1. The MCCB shall be complying with IS: 13947 Part II.
2. MCCBs shall be triple pole (TP) / four pole (FP) quick break and quick make type and shall be trip free.
3. Short circuit withstanding capacity shall be as indicated in the respective drawings.
4. The insulating case of the MCCBs shall be made of high strength heat resistant, flame retardant and thermosetting material so as to provide the following important functions;
  - (a) Safety of operating personnel.
  - (b) Very high dielectric strength
  - (c) High withstanding capacity against thermal and mechanical stresses.
5. The contact system shall be maintenance free with arc extinguishing devices & properties.

**6. Terminations:**

The following features shall be provided for terminals;

- (a) Interchanging capability for line & load ends
- (b) Extended terminals to connect Aluminium cables of required runs & sizes.
- (c) Copper cable termination without extended termination accessories.

**7. Visual indications:**

The following visual indications shall be provided for the MCCBs;

- (a) "ON"
- (b) "OFF"
- (c) "TRIP"

8. The MCCBs shall have adjustable/fixed thermal overload setting and adjustable/fixed magnetic setting as per the drawings or specifications.

9. The MCCBs shall be of Microprocessor/Ordinary based and shall be of Manual /Motorised type and if motorised type the motor shall be driven by either 240/415V supply as per the requirements indicated in the drawings and specifications.

10. Minimum one No. (1 No.) NO / NC / Change Over auxiliary contact shall be available for



“ON”, “OFF”, & “TRIP” positions.

11. For 4 pole MCCBs, the neutral contact shall make earlier than the phase but while tripping, the neutral contact shall break later than the phase for safety purposes.
12. Positive indication of neutral shall be available.
13. Accessories:

The following accessories shall be a standard feature of the MCCB;

- a. Shunt trip suitable for 220V / 415V AC.
- b. Under Voltage trip suitable for 220V / 415V AC.
- c. Auxillary Switches.
- d. It should be possible to connect the earth fault module if indicated in the drawings.
- e. Rotary handle operating mechanism with locking arrangement as indicated in the drawing & specifications.
- f. Any other accessory as indicated in the drawings.

## **IL. MINIATURE CIRCUIT BREAKER**

**IL1.0** The MCB shall comply with IS 8828-1996 / IEC 898-1995. Available in 1,2,3 & 4 pole version for 230/415 volts, AC, 50 Hz application. The MCB should be suitable for DC and 50 Hz application. The MCB shall be made of self extinguishing tropicalized (95% humidity, 55 deg.C) material. The MCB shall have trip free toggle mechanism. The contact closing shall be independent of the operator speed. The MCB shall be suitable for 35 mm DIN rail mounting in any plane without derating. The terminals should be protected against finger contact to IP 20 degree of protection with no restriction for line and load.

- 1.1 The breaking capacity (icn) shall be 10 kA in accordance with IS 8828-1996
- 1.2 The MCB shall be truly current limiting with an energy limiting class'3' for the entire range.
- 1.3 The manufacturer shall define the tripping characteristics of their MCBs and furnish the respective tripping curves.
- 1.4 The power loss per pole shall be in accordance with IS 8828-1996
- 1.5 The rated impulse voltage (U imp) of the MCB shall be >4 kV.
- 1.6 The MCB shall be tested for a vibration stability of at least '5g'
- 1.7 The electrical endurance of the MCB shall not be less than 20,000 operations.
- 1.8 The MCB shall be capable of being used as incomer and isolator applications

- 1.9 The MCB shall have accessories like auxiliary switch, alarm switch, shunt trip, under voltage trip etc.

Note: All MCBs shall be applicable for AC/DC applications

**IM. EARTH LEAKAGE CIRCUIT BREAKER / RESIDUAL CURRENT BREAKER****CIRCUIT****IM 1.0 GENERAL**

RCCB shall be of 2 pole OR 4 pole versions with threshold sensitivities of 20 / 30 / 100 / 300mA and current ratings from 25 to 80 A & shall comply with IS12640 – 1988/IEC 1008. Pole version shall have a width not exceeding 36 mm.

- 1.1 RCCB shall be suitable for use with pure AC / AC with DC offset, for frequency range of 50 Hz to 400 Hz.
- 1.2 It shall have a trip free mechanism and toggle shall give a positive contact indication.
- 1.3 RCCB's operating temperature range shall be -5°C to +60°C.
- 1.4 RCCB shall be suitable for mounting on 35mm DIN rail / surface mounting. RCCB may be installed horizontally, vertically, on the ceiling, in any plane without any change in the electrical performance.
- 1.5 Degree of protection when RCCB is flush mounted, shall be IP40.
- 1.6 RCCB casing shall be made of self extinguishing, tropicalized material.

**IM 2.0 CHARACTERISTICS**

- 2.1 The short circuit withstand of the RCCB without the associated short circuit/overload protection shall not be less than 10kA.
- 2.2 The RCCB shall be of 'inherent current' type i.e. it shall be operationally independent of line voltage.
- 2.3 The rated impulse voltage  $U_{imp}$  shall not be less than 6kV.
- 2.4 The sensitivity thresholds (20, 30, 100, 300 mA) shall be of non-user adjustable type by construction.
- 2.5 The electrical and mechanical endurance of the RCCB shall be substantially higher than those stipulated in the standard, preferably not less than 20,000 opn.
- 2.6 The RCCB shall be protected against nuisance tripping by a protective device, limiting such tripping to a peak value of 250A according to the 8/20 wave for instantaneous devices and a peak of 3kA for selective devices.
- 2.7 The incoming and outgoing terminals of the RCCB shall be suitable for multiple cable wiring, finger safe to IP20 degree of protection. Further, the terminals shall be protected to IP40 if necessary by addition of terminal shields. The cable clamping screws shall be of the captive type

**ACCEPTED MAKE OF MATERIALS****FOR INTERNAL ELECTRICAL WORKS**

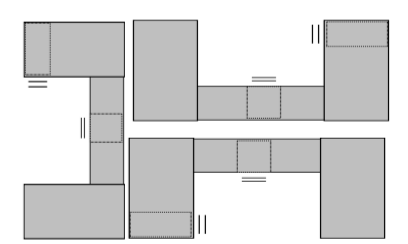
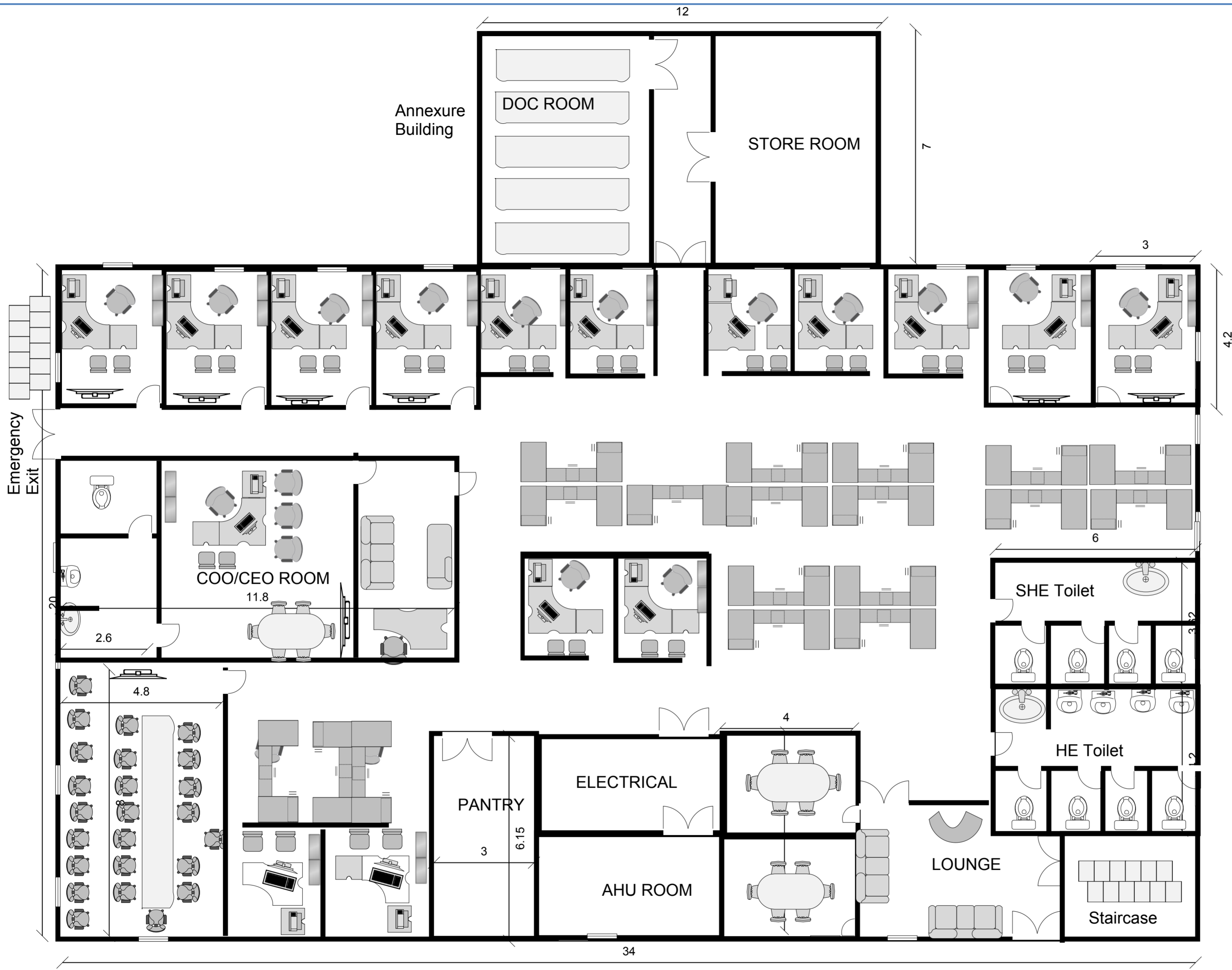
1	MCCB	: ABB/SIEMENS/MERLIN GERIN(IMPORTED)
2	LT CABLES	: /POLYCAB/RR/ KEI/ Universal Cables.
3	CABLE GLANDS (DOUBLE COMPRESSION)	: DOWELL/COMET/GRINDWELL
4	MCB/MCB DISTRIBUTION BOARDS WITH 10KA FAULT LEVEL	: ABB/SCHNIEDER
5	MODULAR TYPE SOCKET OUTLETS	: ANCHOR ROMA/MK-INDIA/CRABTREE
6	INDUSTRIAL TYPE SOCKET OUTLETS (METAL CLAD)	: INDO-ASIAN /BCH/ MDS /SCAME
7	CEILING FANS	: CROMPTON GREAVES/GE/USHA/BAJAJ.
8	EXHAUST FANS	: CROMPTON GREAVES/GEC/USHA/ALMONARD.
9	PVC WIRES-(FRLS)1100V GRADE	: ANCHOR/HAVELLS/FINOLEX/ RR KABEL.
10	CONTACTORS/OL RELAYS	: L&T/ABB/TELEMECHANIQUE.
11	PVC CONDUITS & ACCESSORIES (HEAVY DUTY ONLY)	: VIP/NELCO/UNIVERSAL.
12	MS CONDUIT AND ACCESSORIES	: GI BHARAT/SUPREME/KK INDUSTRIES.
13	LIGHT AND FAN SWITCHES, ELECTRONIC REGULATOR	: ANCHOR ROMA/CRABTREE/MK-INDIA
14	WALL MOUNTED FANS	: ALMONARD/CROMPTON GREAVES/BAJAJ.
15	FABRICATED ENCLOSURES	: RITTAL/ENCLOTEK.
16	PERFORATED CABLE TRAYS/ LADDER CABLE TRAYS	: PROFAB/PATNI/SHRIFABS.

- 17 LAN SOCKETS : ANCHOR ROMA/CRABTREE/MK-INDIA
- 18 LAN network CABLES :DELTON/RPG

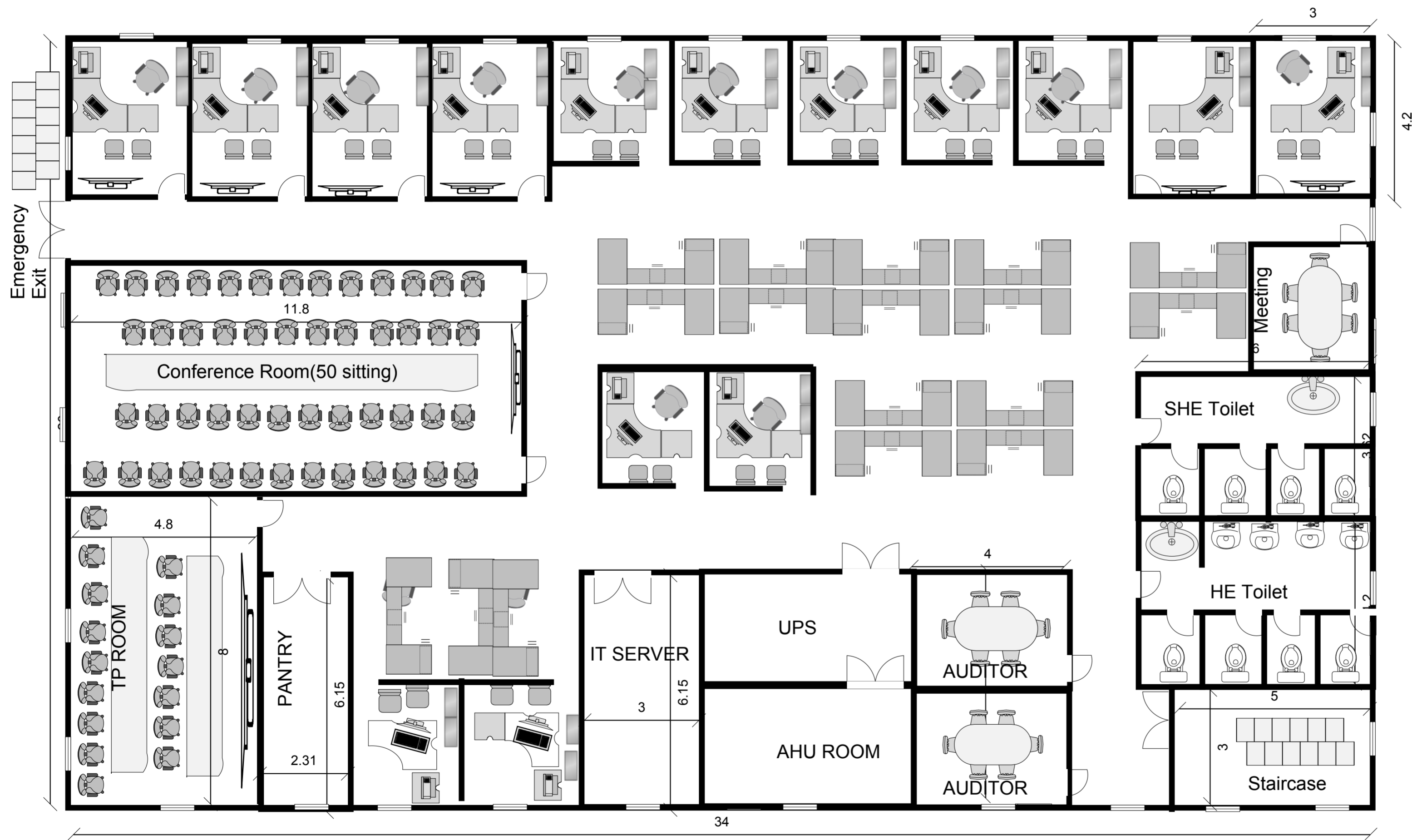
**FOR LT PANELS**

- 1 ACB : ABB/SIEMENS/MERLIN GERIN (IMPORTED)
- 2 MCCB : ABB/SIEMENS/MERLIN GERIN (IMPORTED)
- 3 CAPACITOR (APP) : BARON/MEHER/SIEMENS(EPCOS).
- 4 PF RELAY : EPCOS/BELUK
- 5 PROTECTIVE RELAYS : ALSTOM/AVK-SEGC
- 6 UV/OV,ELR ETC. : MINILEC/PROK DEVICES
- 7 SWITCH DISCONNECTOR FUSE UNITS : ABB/SIEMENS/MERLIN GERIN(IMPORTED).
- 8 LOAD BREAK ISOLATOR : HPL SOCOMEC/ABB/SIEMENS
- 9 LOAD BREAK CHANGEOVER SFU/ISOLATOR : HPL SOCOMEC/ABB/SEIMENS.
- 10 HRC FUSES/BASE : ABB/MG(IMPORTED)/SIEMENS.
- 11 HRC FUSE LINK FOR FDSU : ABB/MG(IMPORTED)/SIEMENS.
- 12 CTS-RESIN CAST : KAPPA/VOLTAMP/KALPA.
- 13 SELECTOR SWITCHES : SIEMENS/KAYCEE.
- 14 INDICATING LAMPS/PUSH BUTTONS : TECKNIK/SIEMENS/ESBEE/ VAISHNO.
- 15 PVC WIRES-1100V GRADE : FINOLEX/RRKABEL/POLYCAB.
- 16 FRLS WIRES-1100V GRADE : FINOLEX/RRKABEL/POLYCAB.
- 17 CONTACTORS/OL RELAYS : SIEMENS/ABB/TELEMECHANIQUE.
- 18 INDICATING METERS (ANALOG) : AE/IMP/MECO/RISHAB.
- 19 INDICATING METER (DIGITAL) : ENERCON/NEW HORIZON INC/ELECTREX

- 20 DIGITAL METER/LOAD MANAGERS : ENERCON/ELECTREX(NEW HORIZON INC).
- 21 FABRICATED ENCLOSURES : OWN FABRICATION



Site:	Drawing: TSPL/BID/SERVICE BLDG/001	Project: Civil Architecture	Drawn: Projects-TSPL	Notes:	3X660MW Talwandi Sabo Power Limited, Mansa, Punjab
Title:	Scale: 1:100	Date: 5/05/2018	Rev: C		Service Building- Ground Floor Plan- FOR Bidding Purpose



Site:

Drawing:  
TSPL/BID/SERVICE  
BLDG/002

Project:  
Civil Architecture

Drawn:  
Projects-TSPL

Notes:

3X660MW Talwandi Sabo Power  
Limited,Mansa, Punjab

Title:

Scale:  
1:100

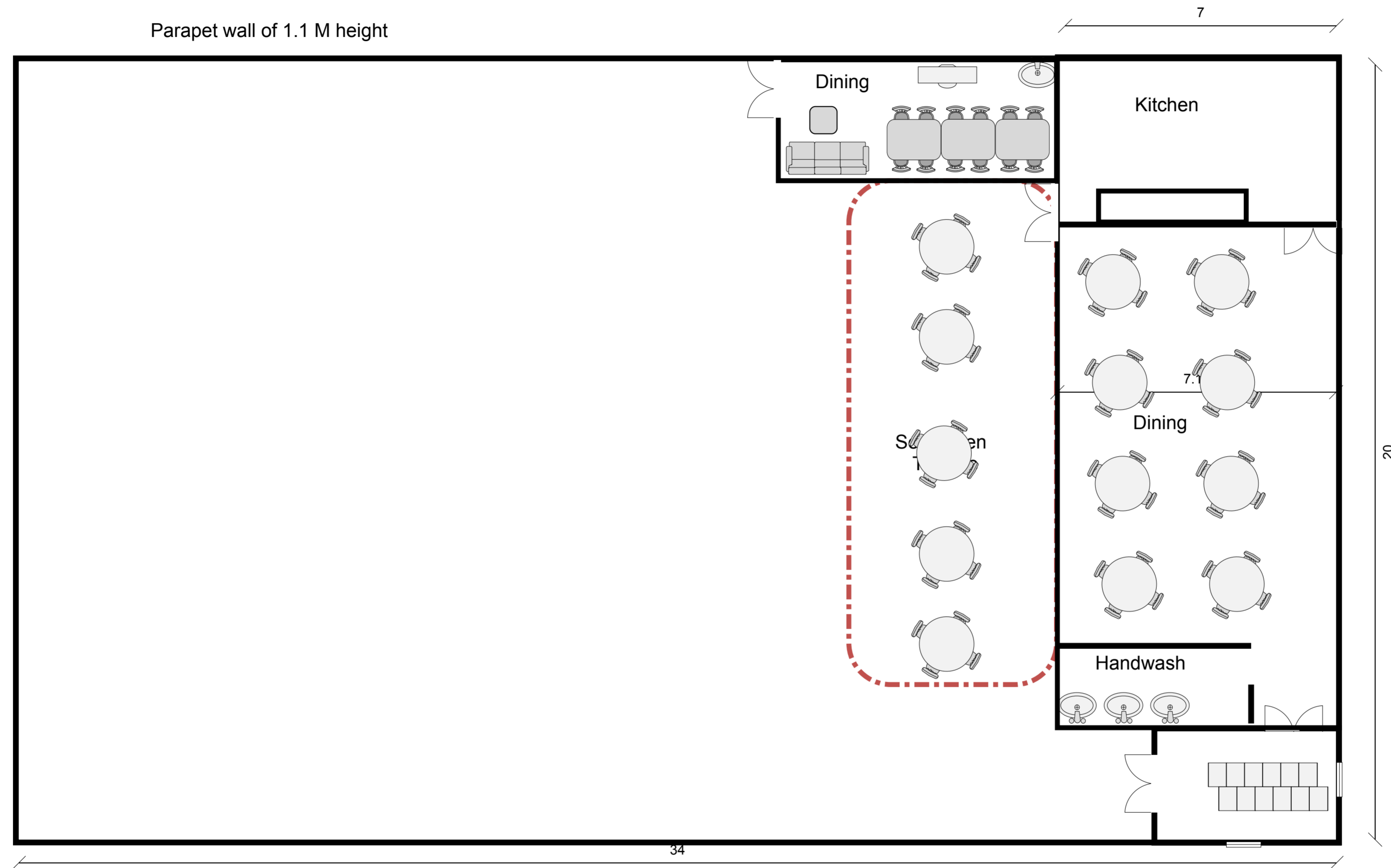
Date:5/05/2018

Rev:  
B

Service Building- First Floor  
Plan- FOR Bidding Purpose



Parapet wall of 1.1 M height



Site:

Drawing:  
TSPL/BID/SERVICE  
BLDG/003

Project:  
Civil Architecture

Drawn:  
Projects-TSPL

Notes:

3X660MW Talwandi Sabo Power  
Limited, Mansa, Punjab

Title:

Scale:  
1:100

Date: 5/05/2018

Rev:  
B

Service Building- 2nd Floor  
Plan- FOR Bidding Purpose



**Talwandi Sabo Power Limited**

And

XXXXXXXXXXXXXXXXXX

**Contract# xxxxxxxxxxxxxx**

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**CONTRACT FOR PROVISION OF [ ] SERVICES**

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THIS AGREEMENT is made on **XXXXXXXXXX**

**BETWEEN**

- (1) **TALWANDI SABO POWER LIMITED**, a company incorporated in India currently having its registered office at \_\_\_\_\_, (hereinafter referred to as the “Company”, which expression, unless the context requires otherwise, shall include its successors and permitted assignees); and
- (2) **XXXX** a company incorporated under the provisions of Company Act, 1956 and having its registered office at **XXXXXXXXXXXXXXXXXXXX** (hereinafter referred to as the “Service Provider”, which expression, unless the context requires otherwise, shall include its successors and permitted assignees).

**RECITALS:**

**WHEREAS** the Company requires the Service Provider to provide certain services and the Service Provider is engaged in the business of providing such services and has agreed to perform the Services for the Company on the terms and conditions set out in this Contract.

**NOW THEREFORE IT IS HEREBY AGREED** as follows:

1. The Service Provider agrees to perform the Services in accordance with the terms and conditions of this Contract and, in consideration of its due performance of the Services, the Company agrees to pay the Service Provider according to the rates, terms and conditions herein contained.
2. The Contract shall comprise the following documents:

This Agreement  
Schedule I: Standard Terms and Conditions  
Attachment 1 to Schedule I: Scope of work  
Attachment 2 to Schedule I: Compensation Schedule

(all hereinafter the “**Agreement**”).

3. In the event of any inconsistency or discrepancy between any of the documents listed above, the Standard Terms and Conditions shall have preference over any other documents and these Standard Terms and Conditions shall apply and shall be incorporated by reference / deemed incorporated in any Purchase Order issued hereunder and shall prevail at all times between the Parties over any other terms and conditions (including any terms or conditions which Service Provider purports to apply except where the Parties by its/their authorized signatories have specifically agreed in writing to vary and override the said Standard Terms and Conditions.
4. The effective date of this Agreement shall be **\*\*\*\*\*** (hereinafter the “**Effective Date**”) and this Agreement shall be valid for a period of **\*\*\*\*\*** from the Effective Date / up to **\*\*\*\*\*** (“**Term**”).
5. For the purposes of Clause 8 (Payment) of Schedule I (Standard Terms and Conditions), the address for sending invoices shall be as follows:

\_\_\_\_\_  
**Contact:**  
**Email:**  
**Attention:**

6. For the purposes of Notices Clause of Schedule I (Standard Terms and Conditions), the address for notices shall be:

If to the Company:

**Talwandi Sabo Power Limited**

\*

\_\_\_\_\_  
**Attention:**

**Email:** \*\*\*\*\*

**Ph:** \*\*\*\*\*

If to the Service Provider:

XXXXXXXXXXXXXXXXXX

7. For the purposes of this Agreement, the Company's representative shall be \*\*\*\*\* & for operational matters shall be \*\*\*\*\*. The Service Provider's representative shall be XXXXXXXXX for all matters, including contractual and operational.

**IN WITNESS WHEREOF** the Parties hereto have executed this Agreement on the day, month and year herein above written:

Signed by.....

.....[Witness Name]

Signed by.....

.....

.....

for and on behalf of **VEDANTA LIMITED**

for and on behalf of XXXXXXXXXXXXX

Witness.....

Witness.....

.....

**PLEASE TICK:**

- WE HAVE READ THE STANDARD TERMS AND CONDITIONS ENCLOSED WITH THIS AGREEMENT**

**SCHEDULE I****STANDARD TERMS AND CONDITIONS**

Services Standard  
Terms & Conditions.p

SSA001

**ATTACHMENT 1 to SCHEDULE I**

**SCOPE OF WORK**

SSA001

**ATTACHMENT 2 to SCHEDULE I****COMPENSATION SCHEDULE****1. COMPLETENESS OF PRICING**

All rates, sums, charges and prices referred to in this Schedule:

- (a) are stated in Indian rupees (INR).
- (b) are considered complete and fully inclusive in respect of the services being provided and no additional rates, sums, charges or prices shall be paid, except as expressly stated in the Agreement;
- (c) shall remain fixed and firm and shall not be subject to amendment for any cause, except as expressly stated in the Agreement.

The cost of any item where the price is left blank shall be deemed included elsewhere.

**2. Taxes**

The prices and rates set out in this Schedule II (Compensation Schedule) are:

- (a) inclusive of all Indian direct taxes (including without limitation personnel taxes, withholding taxes and corporate taxes) now or hereafter levied or imposed on the Service Provider; and
- (b) inclusive of all non-Indian taxes (whether direct or indirect) now or hereafter levied or imposed on the Service Provider; and
- (c) Inclusive of all taxes/levies/duties as applicable except for Service Tax which shall be paid over and above the below mentioned charges as per applicable rates, current rate is [ ]%.

**3. Withholding Tax**

TDS shall be deducted as per the applicable rates under Income Tax Act and same shall be in Service Provider's account only.

**4. Pricing Tables**

## SCHEDULE I

## STANDARD TERMS AND CONDITIONS

### 1. DEFINITIONS

1.1 In the Agreement, the following words and expressions shall, unless the context otherwise requires, have the following meanings:

**"Affiliate"** shall mean with respect to any person, any other person that, directly or indirectly, controls, is controlled by or is under common control of such specified person. For the purposes of this definition, "control" means the direct or indirect beneficial ownership of more than fifty percent (50%) of the issued share capital, stock or other participating interest or the legal power to direct or cause the direction of the general management of the company, partnership or other person in question, and "controlled" shall be construed accordingly;

**"Agreement"** shall mean the Agreement between the Company and the Service Provider to which this Schedule is attached.

**"Purchase Order"** shall mean the document recording the specific Services to be carried out under this Agreement, from time to time.

**"Fees"** shall mean the prices and/or rates payable by the Company in respect of the Services and/or as specified in the relevant Purchase Order.

1.2 Unless otherwise stated, any and all references in the Agreement to Clauses are references to the Clauses of the Agreement.

1.3 The headings in the Agreement are used for convenience only and shall not govern or affect the interpretation of the Agreement.

1.4 Words denoting the singular shall include the plural and vice versa, where the context requires.

1.5 Except as expressly identified, any reference to statute, statutory provision or statutory instrument shall include any re-enactment or amendment thereof for the time being in force.

1.6 Unless expressly stated otherwise, all references to days, weeks, months and years shall mean calendar days, weeks, months and years.

### 2. SCOPE OF CONTRACT

2.1 The terms and conditions of the Agreement shall apply from the Effective Date and shall remain valid for the Term unless this Agreement is terminated earlier by the Company in accordance with Clause 10 below (Standard Terms and Conditions).

2.2 Subject to the provisions of this Agreement, the Parties agree that upon request of the Company in terms hereof, the Service Provider shall perform the Services at such locations and for such periods as may be agreed with the Company.

2.3 From time to time, the Company may issue a Purchase Order to the Service Provider. In such case, the terms and conditions of this Agreement shall apply to each such Purchase Order as if repeated in total.

2.4 The Service Provider shall commence the Services on the scheduled commencement date stated in the Purchase Order and shall continue such Services for the duration of the Purchase Order. Each Purchase Order is subject to agreement on a case by case basis.

### 3. SERVICES

3.1 The Service Provider shall perform the Services with all due skill, care and diligence in a safe, competent and timely manner and in accordance with the requirements of the Agreement and/or the relevant Purchase Order.

3.2 Except to the extent that it may be legally or physically impossible, the Service Provider shall comply with the Company's instructions and directions in all matters relating to the Services consistent with the provisions hereunder.



3.3 The Service Provider shall agree with the Company in the relevant Purchase Order from time to time as regards the personnel who will perform the Services and shall:

- (a) only provide such personnel who possess appropriate experience, skills and qualifications necessary for the Services to be performed in accordance with this Agreement;
- (b) not remove or replace such personnel without the prior written consent of the Company (not to be unreasonably withheld); and
- (c) nominate a senior manager or director of the Service Provider to have overall responsibility for the provision of the Services in terms of the relevant Purchase Order, which person shall attend any meetings with the Company on reasonable prior notice.

3.4 The Company shall be entitled to request the Service Provider to replace any of its personnel providing the Services, where in the Company's reasonable opinion such person is incapable and or unsuitable for performing the Services required by this Agreement. The Service Provider shall promptly replace such person at no additional cost to the Company.

3.5 Without prejudice to any other rights of the Company under the Agreement or at law, if the Service Provider fails to perform the Services in accordance with the provisions of this Agreement, the Company may use alternative means to perform the Services and the Service Provider shall be liable for any additional cost incurred by the Company in using such alternate means.

#### **4. FEES**

4.1 The Company shall pay for the Services performed in accordance with the prices as per Attachment 2 to Schedule 1 and/or rates specified in the relevant Purchase Order.

4.2 In case of contingency assignments, the agreed fees for such onetime Services shall

be payable on completion of the relevant assignment as per the Purchase Order.

#### **5. SERVICE PROVIDER'S GENERAL OBLIGATIONS**

5.1 The Service Provider shall, and the Service Provider shall ensure that its employees and representatives shall, in performing its obligations under this Agreement, comply in all respects with all relevant laws, statutes, regulations and orders for the time being in force.

5.2 Where any of the Service Provider's employees or representatives is present at any of the Company's premises for the purposes of this Agreement, the Service Provider shall at all times remain responsible for the conduct and safety of such employee or representative.

5.3 The Service Provider shall not, in performing its obligations under this Agreement, hold itself out or permit any person to hold it out as being authorised to bind the Company in any way and will not commit any act which might reasonably create the impression that it is so authorised.

5.4 The Service Provider shall ensure that it has in place and maintains in place for the duration of this Agreement sufficient insurance to comply with all applicable laws and to cover its potential liabilities under this Agreement and shall provide evidence of such insurances to the Company on request.

5.5 The Service Provider may not subcontract any of its obligations under this Agreement without the prior written consent of the Company. The Service Provider shall not be relieved from any of its obligations or liabilities under the Agreement by virtue of any subcontract and the Service Provider shall be responsible for all Services, acts, defaults or omissions of its subcontractors (and its or their employees and consultants) as though they were the services, acts, defaults or omissions of the Service Provider.

5.6 In performing the Services, the Service Provider shall:

- (a) give preference to the purchase and use of goods manufactured, produced or supplied in India provided that such goods are available on terms equal or better than imported goods with respect to the timing of delivery, quality, quantity required, price and other terms;
- (b) subject to Clause 5.5, employ Indian subcontractors having the required skills or expertise to the maximum extent possible insofar as their services are available on comparable standards with those obtained elsewhere and at competitive prices and on competitive terms, provided that where no such sub-Contractors are available, preference shall be given to non-Indian subcontractors who utilise Indian goods to the maximum extent possible, subject to the proviso in Clause 5.6 (a) above; and
- (c) subject to Clause 5.5, co-operate with and assist Indian companies as subcontractors to enable them to develop skills and technology to service the petroleum industry.

5.7 The Service Provider shall maintain proper and accurate records in relation to the Services and shall provide copies of the same to the Company on request. The Company (or its appointed representative) shall have the right to audit the relevant books and accounts of the Service Provider in relation to any reimbursable charges paid for by the Company under this Agreement. Such audit right shall survive for a period of 2 (two) years following the expiry or termination of the Agreement. Any incorrect payments identified by such audit shall be adjusted between the Parties as appropriate.

## **6. THIRD PARTY CLAIMS AND LIMITATION OF LIABILITY**

6.1 The Service Provider shall be liable for and shall defend, indemnify and hold the Company harmless from and against any and all claims, liabilities, costs, damages and expenses (including court costs and legal fees) in connection with:

- (a) any claim made by any third party (including, but not limited to, any claim made by any governmental or statutory authority) against the Company arising out of or in connection with the performance by the Service Provider of its obligations under this Agreement.
- (b) any infringement (whether actual or alleged) of any patent or other intellectual property right arising out of or in connection with the performance of this Agreement by the Service Provider.

6.2 Notwithstanding anything to the contrary in this Agreement, in no event shall either Party be liable to the other, whether arising under Agreement, tort (including negligence), strict liability or otherwise, for any indirect, consequential, special, punitive, exemplary or incidental loss or damages of any nature arising at any time from any cause whatsoever.

## **7. VARIATIONS**

7.1 At any time during this Agreement, the Company may request the Service Provider to vary, amend or otherwise alter the Services (a "Variation Request").

7.2 Upon the receipt of a request from the Company pursuant to Clause 7.1, the Service Provider shall, within 7 days, notify the Company of the effect of the Variation Request on the Fees and/or other terms of the relevant Order.

7.3 If following receipt of the Service Provider's response pursuant to Clause 7.2, the Parties are in agreement on the Variation Request and the adjustments to be made to the

relevant Purchase Order, the Parties shall execute a variation order (a "Variation Order") to reflect such agreement.

- 7.4 The Services shall not be varied, amended or otherwise altered and/or the Fees shall not be adjusted until such time as a Variation Order is executed by both Parties.

## 8. PAYMENT

- 8.1 In addition to any requirements set out in the relevant Purchase Order, each invoice shall:

- (a) be in duplicate;
- (b) bear the Contract Number stated on the cover sheet to the Agreement;
- (c) state the name, e-mail address, mobile telephone number of the Company's Representative; and
- (d) be accompanied by supporting evidence and itemised in accordance with the Company's requirements.

Specifically, the Service Provider shall submit the following information/documents to the Company:

- (i) Copy of registration certificates under Indian tax/other laws including but not limited to Service Tax, Excise, import export code etc., as applicable.
- (ii) Copy of PAN.

Invoices to the Company shall be sent to the address set out in the Agreement. Service Provider must ensure that all invoices for services performed or goods delivered are submitted to the Company within 90 days.

- 8.2 The Company shall make payment of a correct invoice within 45 days of receipt to the Service Provider's nominated bank account. Any invoice not complying with the provisions of this Agreement will be returned by the Company and the Service Provider shall submit a rectifying invoice.

- 8.3 The Company may dispute any amount on an invoice and withhold the disputed amount provided that:

- (a) the Company makes payment of any undisputed portion of the invoice and notifies the Service Provider of the disputed amount within 45 days of receipt of the relevant invoice;
- (b) if the dispute is resolved in favour of the Service Provider, the Company shall pay the disputed amount within fifteen (15) days of the date of the resolution of the dispute or forty-five (45) days of receipt of the invoice, whichever is later.

If the dispute is resolved in favour of the Company, the Service Provider shall forthwith issue a credit note for the disputed amount.

- 8.4 The Company shall be entitled to set-off / adjust / deduct from any invoice under this Agreement, any payment due from the Service Provider to the Company or any of its Affiliates.

## 9. TAXES

### 9.1 Definitions

For the purposes of this Clause 9:

- (a) "Tax" or "Taxes" means taxes, levies, duties, fees, charges and contributions as amended from time to time and any interest or penalties thereon;
- (b) "Government Authority" or "Government Authorities" means any local or national government or authority of any country, competent to levy any Tax.

### 9.2 Person Responsible for payment of Taxes

Except as may be expressly set out in this Agreement, the Service Provider shall be responsible for:

- (a) the payment of all Taxes now or hereafter levied or imposed on the Service Provider or its subcontractors or on the personnel of the Service Provider or its subcontractors by any Government Authority in respect of any wages, salaries and other remuneration paid directly or indirectly to persons

- engaged or employed by the Service Provider or its subcontractors (hereinafter referred to as "Personal Income tax");
- (b) the payment of all Taxes now or hereafter levied or imposed by any Government Authority on the actual/assumed profits and gains made by the Service Provider or its subcontractors (hereinafter referred to as "Corporate Income tax");
- (c) the payment of all Taxes now or hereafter levied or imposed by any Government Authority on the services, if any, provided to the Company by the Service Provider or its subcontractors (hereinafter referred to as "Service tax");
- (d) the payment of all Taxes now or hereafter levied or imposed by any Government Authority on the goods, if any, sold to the Company by the Service Provider or its subcontractors (hereinafter referred to as "Sales tax/VAT");
- (e) the payment of all Taxes now or hereafter levied or imposed by any Government Authority on the goods, if any, manufactured by the Service Provider or its subcontractors for sale to the Company (hereinafter referred to as "Excise Duty"); and
- (f) the payment of any other Taxes now or hereafter levied or imposed by any Government Authority on the Service Provider or its subcontractors as a result of the performance of this Agreement.

**9.3 Withholding taxes and Withholding certificates**

- 9.3.1 The Company shall, at the time of its payments due to the Service Provider, withhold the necessary taxes at such rate as is required by any Government Authority, unless and to the extent that the Service Provider shall produce to the Company any certificate issued by a Government Authority (having authority to issue such certificate) entitling the Service Provider to receive the payments under the Agreement for a prescribed period without deduction of any tax or deduction at a lower rate.

- 9.3.2 The Company shall provide the necessary withholding tax certificates to the Service Provider within the time stipulated by the relevant law to enable the Service Provider to file the same with the Government Authority as a proof of payment of such taxes.

**9.4 Person Responsible for filing of returns / information to Government Authorities**

- 9.4.1 The Service Provider shall be responsible for filing all necessary Tax returns (including, without limitation, returns for Corporate Income tax, Personal Income tax, Service tax, Sales tax and Excise Duty) with the relevant Government Authorities in accordance with all applicable statutory requirements and shall be responsible for providing all information requested by such Government Authorities.
- 9.4.2 The Service Provider shall also ensure that its sub-Contractors file such returns as stipulated by the relevant Government Authorities and furnish such information as requested for by the relevant Government Authorities.
- 9.4.3 The Company, with respect to the tax withheld from the Service Provider in accordance with Clause 9.3 (Withholding Tax and Withholding Tax Certificates), shall be responsible for filing the withholding tax returns with the relevant Government Authorities in accordance with applicable statutory requirements.

**9.5 Company's rights, if treated as representative assessee by Government Authorities**

In certain situations, a Government Authority may treat the Company as the representative assessee of the Service Provider and/or its subcontractors and recover the Taxes due to the Government Authority by the Service Provider or its subcontractors from the Company. In such situations, the Company shall have the following rights:

- (a) The Company shall be entitled to recover from the Service Provider, the Taxes paid on behalf of the Service

Provider or its sub-contractors (together with any costs and expenses incurred by the Company in connection therewith) or to retain the same out of any amounts to be paid to the Service Provider or its sub-contractors that may be in its possession (whether due under this Agreement or otherwise) and shall pay only the balance, if any, to the Service Provider; and

- (b) If the Company is required to furnish any details or documents in such capacity, the Company shall request the details or documents to be furnished to it by the Service Provider and the Service Provider shall immediately furnish the same to the Company. If the Service Provider fails to comply with the foregoing, any penalty/interest levied on the Company for non-filing or late filing of details or documents in this regard shall be recoverable from the Service Provider.

#### **9.6 Indemnity**

The Service Provider shall defend, indemnify and hold the Company harmless from and against any and all claims, liabilities, costs, damages and expenses (including court costs and legal fees) in connection with any Taxes which may be levied or imposed on the Service Provider or its sub-contractors by any Government Authority arising out of or in connection with the performance of this Agreement.

#### **9.7 Changes in Law**

If, after the date of execution of this Agreement, there is any change in law which results in a change in the rate of any Tax included in the Service Provider's prices or rates or the introduction of a new Tax and such change results in an increase or decrease in the cost to the Service Provider of performing this Agreement then the Parties shall agree to a revision in pricing to reflect such change provided that:

- (a) the Party requesting such revision shall promptly (and in any case prior to submission of the Service Provider's final invoice under this Agreement)

notify the other Party that such change in law has arisen; and

- (b) the Party requesting such revision shall provide the other Party with documentary proof of such change in cost to the reasonable satisfaction of the other Party; and
- (c) the provisions of this Clause 9.7 shall not apply to changes in Personal Income tax or Corporate Income tax or to changes in non-Indian Taxes.

#### **10. TERMINATION**

10.1 Either Party may, at any time and without cause, terminate all or part of this Agreement by giving no less than [30] days' prior written notice to the other Party. Provided that, if any Purchase Order has already been initiated and the work is in progress, then the Company only shall have the right to cancel/ terminate any Work under the relevant Purchase Order as specified in such Purchase Order without cause and with immediate effect.

10.2 In addition, the Company may terminate all or part of this Agreement with immediate effect by written notice to the Service Provider if one of the following circumstances occurs:

- (a) if the Service Provider breaches any provision of this Agreement, provided that where remediable, the Company has notified the Service Provider of such breach and the Service Provider has upon receipt of such notice, failed to immediately and thereafter continuously proceed to remedy such breach to the Company's reasonable satisfaction; or
- (b) if the Service Provider becomes insolvent or bankrupt or makes a composition or arrangements with its creditors; or
- (c) if the Service Provider is wound up or a resolution for its winding up is made (other than for the purposes of

an amalgamation or reconstruction whilst solvent); or

(d) if the Service Provider has a liquidator, provisional liquidator, receiver, administrator or an administrative receiver or manager of its business or undertaking appointed; or

(e) if the force majeure under Clause 14 continues for more than thirty (30) days.

10.3 In the event of cancellation/ termination of all or part of this Agreement for any reason, the Company's sole liability to the Service Provider in respect of such cancellation/ termination shall be to make payment of the Fees properly due under this Agreement up to the date of termination.

10.4 The expiry or termination of this Agreement shall be without prejudice to the rights and obligations of the Parties up to and including the date of expiry or termination and shall not affect or prejudice any term of this Agreement that is expressly or by implication provided to come into effect on, or continue in force after, such expiry or termination.

## **11. CONFIDENTIALITY**

11.1 The Company and the Service Provider shall keep any information which either Party learns about or receives from the other pursuant to this Agreement in strict confidence and will not disclose the same to any third party without the prior written consent of the other Party. The foregoing restriction shall not apply in respect of information which the Company requires to disclose for the purpose of performing Services or which was in the possession of the disclosing party prior to this Agreement or which is required to be disclosed by any law, rule or regulation of any governmental agency or court order. The provisions of this Clause shall survive the expiry of termination of the Agreement for a period of 3 years.

11.2 The Service Provider shall not disclose such Information(s) to any potential subcontractors until such time and in manner agreed by Company in writing. The decision of the Company will be final and binding on the Service Provider in this regard.

11.3 The Service Provider shall use best endeavours to prevent the authorised disclosure of the all information hereunder. Where any information is required to be disclosed under Clause 11.1, the Service Provider shall give prompt notice to the Company and shall use its best commercial endeavours to limit the extent of any such disclosure.

## **12. NOTICES**

12.1 Any notice or other communication required or given under this Agreement shall be delivered in writing either by hand or by courier, registered mail with acknowledgment due, or fax to the address of the relevant Party set out in the Agreement (or such other address as may be notified by the relevant Party from time to time).

12.2 If a notice is delivered by hand or courier during normal business hours of the intended recipient it shall be deemed to have been received at the time of delivery otherwise on the next business day of the recipient. A notice sent by facsimile shall be deemed to have been received at the time when the sender's facsimile machine acknowledges transmission provided however that if the time of acknowledgement of transmission is after 5.00pm on a business day of the recipient it shall be deemed to have been received on the next business day of the recipient.

12.3 All notices or other communications between the Parties shall be in the English language.

**13. GENERAL LEGAL PROVISIONS**

13.1 The Company shall be entitled to assign this Agreement to an affiliate/subsidiary or on giving written notice to the Service Provider. Save as aforesaid, the Service Provider shall not be entitled to assign this Agreement or any part or any benefit or interest in or under it without the prior written approval of the Company which the Company may at its sole discretion accept or refuse.

13.2 This Agreement shall not be amended or modified except by mutual agreement in writing between the Parties.

13.3 This Agreement and the all Schedules and Attachments annexed hereto contains the whole agreement between the Parties relating to the subject matter of this Agreement, and supersedes any previous understandings, commitments, agreements or representations in respect of the subject matter.

13.4 No delay or failure on the part of either Party to enforce from time to time all or any part of the terms and conditions of this Agreement shall be interpreted as a waiver of such terms and conditions.

13.5 Nothing in this Agreement shall, or shall be deemed to, create an agency, a partnership or a relationship of employer and employee between the Parties. For the avoidance of doubt, nothing in this Agreement shall prevent or restrict the Company from entering into parallel Agreements with other parties for services similar or related to the Services.

13.6 Unless otherwise specifically stated, both the Company and the Service Provider shall retain all rights and remedies, both under the Agreement and at law, which either may have against the other.

13.7 Each Party represents and warrants to the other that (i) it has been duly registered and organised and is a validly existing legal entity under the laws of the jurisdiction of its incorporation and that it has full power,

authority and capacity to enter into and to carry out its obligations under the Agreement and (ii) by performing the Services it will not be in breach of any other Agreement, agreement, license or permit or in violation of any law and (iii) it shall at all times act in accordance with applicable laws and regulations.

13.8 The Service Provider shall comply with all safety instructions of the Company consistent with the provisions of the Agreement including, without limitation, the safety instructions of any of the Company's other Service Providers. Such instructions shall, if the Service Provider so requires, be confirmed in writing by the Company's Representative, so far as practicable.

13.9 The Service Provider shall not be entitled, without the written consent of Company, to make any news release or public announcement concerning the subject matter of the Agreement or to refer to the Company, use its name or logo, in print or electronic forms for marketing or reference purposes.

13.10 If any provision of this Agreement is prohibited, invalid or unenforceable in any jurisdiction, that provision will, as to that jurisdiction, be ineffective to the extent of the prohibition, invalidity or unenforceability without invalidating the remaining provisions of this Agreement or affecting the validity or enforceability of that provision in any other jurisdiction, unless it materially alters the nature or material terms of this Agreement.

13.11 The provisions of this Agreement are solely for the benefit of the Parties. No other person are intended to have, nor will have, any rights whatsoever, under this Agreement, whether for injury, loss or damage to person(s) or property or for economic loss.

13.12 This Agreement may be executed in one or more counterparts, each of which will be deemed to be an original copy of this Agreement and all of which, when taken

together, will constitute one and the same instrument.

#### **14. FORCE MAJEURE**

14.1 Neither the Company nor the Service Provider shall be responsible for any failure to fulfil any term or condition of the Agreement if and to the extent that fulfilment has been delayed or temporarily prevented by a force majeure occurrence such as any (a) Act of God, (b) fire, flood, earthquake, (c) war, riot, insurrection and civil commotion, mobilization or military, call up of a comparable scope, which has been notified in accordance with this Clause 14 and which is beyond the reasonable commercial control and without the fault or negligence of the party affected and which, by the exercise of reasonable diligence, the said party is unable to provide against.

14.2 In the event of a force majeure occurrence, the party that is or may be delayed in performing the Agreement shall notify the other party without delay giving the full particulars thereof and shall use reasonable endeavours to remedy the situation without delay.

14.3 Save as otherwise expressly provided in the Agreement, no payments of whatever nature shall be made in respect of a force majeure occurrence.

14.4 Following notification of a force majeure occurrence in accordance with Clause 14.2, the Parties shall meet without delay with a view to agreeing a mutually acceptable course of action to minimise any effects of such occurrence.

#### **15. BUSINESS ETHICS**

15.1 The Service Provider shall declare any conflicts of interest with the Company including relationship or financial interest of any nature whatsoever with employees, managers, other suppliers, vendors or stakeholders of the Company.

15.2 The Service Provider shall not use the services of any of the employees of the Company,

directly or indirectly or enter into any sort of monetary transaction with the employees of the Company. The Service Provider undertakes that he has not given, offered or promised to give directly or indirectly any bribes, commission, gift, consideration, reward, or inducement to any of the employees of the Company or their agent or relatives for showing or agreeing to show favor or disfavor to any person in relation to this Agreement or forbearing to do or for having done or forborne to do any act in relation to the obtaining or execution of the aforesaid undertaking, by the Service Provider, or his partners, agent or servant or any one authorized by him or acting on his behalf. The Service Provider undertakes that in the event of use of any corrupt practices by the Service Provider, the Company shall be entitled to terminate the Agreement forthwith and recover from the Service Provider, the amount of any loss arising from such termination. A decision of the Company or his nominee to this effect that a breach of the undertaking had been committed shall be final and binding on the Service Provider.

15.3 If at any time during execution or performance of this Agreement the Service Provider is faced with any undue demand, request for gratification or favor from any employee of the Company or a person connected with such employee, the Service Provider must report the same immediately at [●] [insert relevant whistleblower email id].

15.4 The Service Provider agrees to comply with the provisions of the Company's Supplier Code of Conduct and the Company's Human Rights Policy including the Modern Slavery Act and in case of breach thereof, the same shall be treated as a breach of this Agreement.

15.5 The Service Provider shall maintain records and provide to the Company upon request such records and evidences, as the Company may reasonably require, confirming the Service Provider's



compliance with the obligations under Clause 15.4.

- 15.6 The Service Provider shall comply with the Anti-Bribery and Corruption (AB&C) requirements as applicable to them.
- 15.7 The Company shall have a right to initiate "audit proceedings" against the Service Provider to verify compliance with AB&C requirements. Such audit may be carried out by Company or by a reputed agency to be appointed by Company at the sole discretion of Company. The Service Provider shall extend full cooperation for smooth completion of the audit mentioned herein.
- 15.8 Notwithstanding anything in this agreement, Company shall have right to terminate the Agreement forthwith in case, it is found that the Service Provider has failed to comply with AB&C requirements.
- 15.9 The Service Provider may submit/report 'Complaints' pertaining to any violation to the Company's ethical business practices as specified in the Company's Code of Conduct Policy.

External stakeholders such as vendors, customers, business partners etc. have the opportunity to submit 'Complaints'; however, the Company is not obligated to keep 'Complaints' from non-employees confidential or to maintain the anonymity of non-employees. We encourage individuals sending 'Complaints'/raising of any matter to identify themselves instead of sending anonymous 'Complaints' as it will assist in the effective complaint review process.

Post review, if the complaint is found to have been made with malafide intention, stringent action will be taken against the complainant. We encourage reporting genuine 'Complaints' and those submitted in true faith.

All the 'Complaints' under this policy should be reported to the Group Head-Management Assurance at the following address:

Group Head – Management Assurance,  
Vedanta, 75 Nehru Road  
Vile Parle (E), Mumbai 400 099

'Complaints' can also be sent to the designated e-mail id: [●] [insert relevant whistleblower email id].

## 16. GOVERNING LAW AND DISPUTE RESOLUTION

16.1 This Agreement shall be governed by, construed and enforced in accordance with the laws of [Local Jurisdiction/Delhi/Mumbai], India.

16.2 Any dispute or difference whatsoever arising between the parties out of or relating to the interpretation, meaning, scope, operation or effect of this Agreement or the existence, validity, breach or anticipated breach thereof or determination and enforcement of respective rights, obligations and liabilities of the parties thereto shall be amicably settled by way of mediation. If the dispute is not conclusively settled within a period of twenty-one (21) days from the date of commencement of mediation or such further period as the parties shall agree in writing, the dispute shall be referred to and finally resolved by arbitration under the Arbitration and Conciliation Act, 1996 (as amended from time to time), which are deemed to be incorporated by reference into this clause. The arbitration shall be conducted as follows:

(i) A sole arbitrator shall be appointed in case the value of claim under dispute is less than ₹ 50,00,000 (Rupees Five Million Only) and in any other event by a forum of three arbitrators with one arbitrator nominated by each Party and the presiding arbitrator selected by the nominated arbitrators.

(ii) The language of the mediation and arbitration proceedings shall be English. The seat of arbitration shall be [Local Jurisdiction/Delhi/Mumbai], India.

(iii) The award made in pursuance thereof shall be final and binding on the parties. The right to arbitrate Disputes under this Agreement shall survive the expiry or termination of the Agreement.